SCIENCE ABSTRACTS.

Section A.—PHYSICS.

OCTOBER, 1927.

GENERAL PHYSICS.

2655. *Mass and Weight.* **P. Melchior.** (Zeits. techn. Physik, 8. 6. pp. 209–216, 1927.)—Criticism of a pamphlet, D I N 1305, issued by the Society of German Engineers (V.D.I.) for the purpose of normalising ideas in regard to mass and weight. The use of the word "weight" in the pamphlet with various meanings gives rise to misunderstandings, and the author sets forth a number of revised definitions for the purposes of the pamphlet. G. E. A.

2656. *A Ball and Tube Flowmeter Suitable for Pressure Circuits.* **J. H. Awbery and E. Griffiths.** (Phys. Soc., Proc. 39. pp. 296–298; Disc., 298–299, June, 1927.)—The paper describes a robust form of the Ewing ball and tube flowmeter, suitable for the metering of gases and liquids under pressure, as, for example, the ammonia in a refrigerating plant. The necessary pressure-tight joints for connecting the conical tube to the circuit are described and also a device for cutting off the flow should the tube fail. An investigation is included of the behaviour of the instrument under practical conditions of pulsating flow [see Abstract 1959 (1927)]. AUTHORS.

2657. *Experimental Study of the Piston Pressure Gauge to 600 Atmospheres.* **F. G. Keyes and Jane Dewey.** (Mass. Inst. of Technology, Contrib. No. 179. Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 491–504, June, 1927.)—The "dead-weight" piston-type pressure gauge is compared with a mercury column according to a modification of the Holborn and Schultze method [see Abstract 92 (1916)]. The column is now jacketed to secure constancy of temperature, an arrangement is introduced to provide an invariable column length of mercury, and means are also described whereby both gauges, if desired, can be used at the floor level. Two pairs of piston gauges of different effective areas are compared with a mercury column (875 cm. long) in a water-jacketed steel tube to 160 atmospheres for the larger piston and to 587 atmospheres for the smaller piston, the larger piston giving true pressures to the limit designed (160 atmospheres), the average deviation being 1 part in 40,000. At 400 atmospheres, the smaller piston commences to show higher values, at 587 atmospheres this deviation increases to 1 part in 11,000, a discrepancy left unexplained until further investigations into the closeness of fit of the piston in its cylinder, the changing conditions of the oil flow along the piston at higher pressures, and the distortion effect upon the cylinder have been carried out. J. K.

2658. *Geodetic Level Rods, their Construction and Method of Graduating.* **D. L. Parkhurst.** (Journ. Sci. Instruments, 4. pp. 284–287, June, 1927.) —The construction and graduations of the rod used in geodetic levelling of the most precise character, the material used and treatment to overcome variations in temperature and humidity are described. The graduating of these rods has been one of the most difficult processes, and a machine is described which has been built for this purpose and performs the most exacting part of the work mechanically. AUTHOR.

2659. *Surface Tensions of Liquid Metals. Part II. Bismuth, Cadmium, Zinc and Antimony.* **L. L. Bircumshaw.** (Phil. Mag. 3. pp. 1286–1294, June, 1927.)—The determinations are carried out by a method described in Part I [see Abstract 12 (1927)]. Owing to the great volatility of Cd and Zn, reliable results cannot be obtained above 600° C. for Cd and 700° C. for Zn. The surface tension of Cd passes through a maximum at 425° C. The bearing of the results on the molar total surface energy is discussed, and evidence is adduced that Bi, Cd and Sb may be highly associated in the liquid state. A. B. C. L.

2660. *Crystal Structure after Milling.* **S. Konobejewski.** (Zeits. f. Physik, 43. 9–10. pp. 741–749, 1927.)—By means of an X-ray study of rolled sheets of aluminium it is found that two structural arrangements dependent on the degree of working are possible. In one, gliding is along the rhombic dodecahedral planes, and in the second along the cube planes. W. H. GE.

2661. *Rate of Crystal Growth in Different Directions.* **Marie Bentivoglio.** (Roy. Soc., Proc. 115. pp. 59–87, June 1, 1927.)—An experimental method by which the relative rates of growth of the faces of a crystal growing in a rotating liquid can be accurately measured has been applied to the isomorphous series $R''R'_2(SO_4)6H_2O$, to $K_2C_4H_4O_6 \cdot \frac{1}{2}H_2O$ and to $(NH_4)_2C_4H_4O_6$. *Under these conditions,* (1) similar faces of a *simple* form always grow at the same rate. (2) On a combination. Unlike faces grow at different rates, but like faces at the same rate unless adjacent to a large fast-growing face of another form which destroys uniformity of the conditions. With this exception there is a constant ratio between the rates of growth of any two different forms. (3) The rates of growth of parallel faces of a crystal having no centre of symmetry may differ widely. (4) The order of increasing rates of growth of different forms in an isomorphous series is *not* the same in different members of the series. W. H. GE.

2662. *The Increase of Brownian Motions by Light.* **W. Pospíšil.** (Ann. d. Physik, 83. 5. pp. 735–752, July 11, 1927.)—It was shown experimentally that the Brownian motions of particles of mastic, which did not absorb the light employed, were not affected by the intensity of that light. It has been supposed that intense illumination, which in some cases increases the Brownian motions, does so by raising the temperature of the fluid and by lowering its viscosity; the experiments showed, however, that the increase in the motions of particles which absorb light (carbon and gutta-percha) cannot be explained fully by reduced viscosity. The main effect is due to a phenomenon similar to that causing photophoresis and radiometer action, and cannot be explained on the lines of the kinetic theory. The Brownian motions are possibly due to photoelectric action, or more probably to the emission by the particle of quanta of infra-red radiation in varying but definite directions. The number emitted will be increased when the particle absorbs light energy, and the Brownian motions will be greater. H. N. A.

2663. *Some Consequences of the Schrödinger Theory for Term Structures.* **E. Wigner.** (Zeits. f. Physik, 43. 9–10. pp. 624–652, 1927.)—In this mathematical paper the author derives some structural properties of spectra from the form of the Schrödinger differential equation, and by quite simple symmetry considerations explains an essential part of purely qualitative spectroscopic experience. Resolution in the electric and magnetic fields, the principles underlying the construction of series spectra, and related phenomena are treated at length. Consideration, however, is mostly limited to singulet systems, the rotating electron receiving only incidental treatment. H. H. Ho.

2664. *Wave Mechanics and the Normal State of the Hydrogen Molecule.* **E. U. Condon.** (Nat. Acad. Sci., Proc. 13. pp. 466–470, June, 1927.)—Makes use of the values of the electronic energy of the hydrogen molecule ion H_2^+ for different nuclear separations calculated by Burrau to discuss, in a semi-quantitative manner, the neutral hydrogen molecule. The starting point for the approximate treatment of the problem is a model, in which the two electrons have no mutual influence, each moving as it would in Burrau's H_2^+ model. The electronic energy of the H_2 model is then twice that for H_2^+; adding the Coulomb proton-proton energy a curve is obtained with minimum energy at a separation of 1·075 units, the unit being the Bohr 1_1 orbit radius of the H atom. The corresponding moment of inertia is $2\cdot7 \times 10^{-41}$ gr. cm.^{2}, and the heat of dissociation $1\cdot800\ R = 24\cdot36$ volts. When electronic interaction is also considered, an energy curve is obtained, the minimum point of which corresponds to a moment of inertia of $4\cdot26 \times 10^{-41}$ gr. cm.^{2}, and a heat of dissociation of 4·4 volts; the latter value is within 0·1 volt of that calculated from the band spectrum by Witmer and by Dieke and Hopfield. Hutchinson found $4\cdot91 \times 10^{-41}$ gm. cm.^{2} for the moment of inertia on the classical quantum theory. H. N. A.

2665. *The Orbits and Radiation of the Hydrogen Electrons.* **T. Engset.** (Ann. d. Physik, 83. 6. pp. 903–904, July 20, 1927.)—The omission of the factor two in one of the formulæ employed in a previous paper [see Abstract 2463 (1927)] has made necessary a number of corrections, which are here given. H. N. A.

2666. *Electronic Affinity of Hydrogen and Densities of the Alkali Hydrides.* **J. Kasarnowsky** and **M. Proskurnin.** (Zeits. f. Physik, 43. 7. pp. 512–515, 1927.)—A recent calculation [see Abstract 2738 (1926)] of the electronic affinity of hydrogen has revealed a contradiction with the data for the densities of the alkali hydrides as determined by Moissan involving not only the lattice energies of the above hydrides, but also the molecular volume additive relationships at high densities. A new determination has now established that the densities for NaH and KH are

really of the expected dimensional order, and their lattice energies furnish the value $E_H = -1$ k.cal., which stands in good agreement with the result found by Pauling [see Abstract 1625 (1927)] from a semi-model calculation.
H. H. Ho.

2667. *Structure of the Helium Atom.* **J. C. Slater.** (Nat. Acad. Sci., Proc. 13. pp. 423–430, June, 1927.)—A new method of finding a soluble approximation to a solution of the problem of calculating the spectrum of helium from the wave equation is presented. Even the soluble unperturbed problem gives results in close agreement with experiment, so that higher approximations, based on the method of perturbations may be expected to converge rapidly. The method appears to be of far-reaching application, and its usefulness in the problems of the higher atoms and of molecular structure is discussed. The mathematical method employed, in which, unlike that previously used for such problems, no attempt is made to separate variables, is explained with respect to a problem of two degrees of freedom, and then applied to the wave equation for helium, which has six variables, the coordinates of the two electrons. A table gives the wave numbers and quantum defects of the 1S and 2S levels, as calculated and as observed (mean of singlet and triplet levels); the agreement is very remarkable. The observed and the calculated ionisation potential values are 24·48 volts and 24·35 volts. H. N. A.

2668. *Calculation of the Spectroscopic Terms Derived from Equivalent Electrons.* **H. N. Russell.** (Phys. Rev. 29. pp. 782–789, June, 1927.)—The calculation of the spectroscopic terms which result from an atomic configuration containing several equivalent electrons, in which Pauli's restriction is operative, can be made very simply by the extension of a notation due to Breit. The results are in agreement with those previously given by Hund for *p* and *d* electrons and those of Gibbs, Wilber and White for *f* electrons. Some minor alterations in notation are suggested.
AUTHOR.

2669. *The Process of Quantisation.* **G. P. Thomson** and **R. G. J. Fraser.** (Phil. Mag. 3. pp. 1294–1305, June, 1927.)—The classical theory involves the assumption of periodic motion of an atomic system in the stationary state. But a motion cannot be truly periodic unless it persists indefinitely, whilst the actual atomic motion is supposed to be liable to interruptions or transitions induced by radiation and collision. The extent to which the actual state differs from the ideal may be termed the diffuseness of quantisation, recently discussed by Ehrenfest and Tolman, Slater and Landé. The authors consider the interruption of atomic motion by collisions with other atoms, and the considerations apply directly only to gases at sufficient densities. The collision will limit the length of the coherent wave-train and hence its homogeneity, and will broaden the lines of the spectrum to an extent depending upon the frequency of collisions, *i.e.*, the gas pressure. Experiments on broadening have mostly been made on the alkali metals which probably form unstable molecules. Füchtbauer and Meier [Abstract 1420 (1927)] found that the broadening of the mercury line 2537 was proportional to the density of the hydrogen or nitrogen atmosphere and to the 2/3 power of the density for CO_2 and was asymmetrical there. The author demonstrates mathematically that the broadening implies the existence of diffusely quantised orbits, and that the energy of the diffused quantised states changes with the time interval between collisions T and the time period of excitation, but is always a fraction of T. The diffuseness would be inversely as N, the number of complete periods elapsed since the last collision. One of the results discussed is that the breadth of the Zeeman components should decrease as the field intensity increases; that would be difficult of experimental test. A note added states that the paper was based upon the ideas developed by de Broglie, and that the wave theory of mechanics may put some of their phraseology out of date. H. B.

2670. *Contribution to Modern Ideas on the Quantum Theory.* **H. T. Flint and J. W. Fisher.** (Roy. Soc., Proc. 115. pp. 208–214, June 1, 1927.)—This entirely mathematical paper discusses the de Broglie phase wave in generalised space-time, and the wave equation as a fundamental law of nature. The mode of procedure worked out appears to render possible the inclusion of gravitational, electrical and quantum phenomena in one uniform scheme. H. H. Ho.

2671. *Quantum Mechanics of the Magnetic Electron.* **W. Pauli, Jr.** (Zeits. f. Physik, 43. 9–10. pp. 601–623, 1927.)—In an earlier publication [see Abstract 1456 (1927)] the Fermi statistics were developed for the electronic gas. It is now shown how a formulation of the quantum mechanics of the magnetic electron can be obtained according to the Schrödinger method of *eigen* functions, without the use of ambiguous functions, but based on the general Dirac-Jordan transformation theory and with the introduction of the components of an *eigen* impulse moment in a fixed direction as further independent variables. In contrast to classical mechanics, the latter, quite independently of any special kind of force field, can only assume the values $\pm \frac{1}{2} h/2\pi$. As a result the *eigen* function is split into two place functions ψ_α and ψ_β, which are considered as probability amplitudes. In a definite stationary state of the system not only do the position coordinates of the electrons lie in infinitesimal intervals, but also the components of the *eigen* moments have values in the chosen direction of $+ \frac{1}{2} d/2\pi$ for ψ_α and $- \frac{1}{2} h/2\pi$ for ψ_β. The simultaneous differential equations of the ψ functions are derived, and, in their consequences, are shown to be fully equivalent to the matrix equations of Heisenberg and Jordan [see Abstract 2372 (1926)]. H. H. Ho.

2672. *Conditions of Validity of Macromechanics.* **M. S. Vallarta.** (J. Math. Phys., Mass. Inst. of Technology, 6. pp. 209–222, June, 1927. Paper read before the Am. Phys. Soc., Feb., 1927.)—The conditions are investigated under which a general form of micromechanics or wave mechanics, including Schrödinger's as a special case, reduces to macromechanics. It is found that free motion and motion in a constant potential field are the only cases where macromechanics will give the same solution as the wave mechanics, unless the waves in the latter have infinite frequency when the two forms of mechanics become identical (the correspondence principle). W. S. S.

2673. *Quantum Jumps without Radiation.* **G. Wentzel.** (Zeits. f. Physik, 43. 8. pp. 524–530, 1927.)—The probability of such jumps can be calculated by wave mechanics. The special case is considered in which an atom, ionised in the K shell, emits an L electron. The paper is mathematical. F. S.

2674. *Note on K. Schaposchnikow's Paper, "A New Principle in the Dynamics of Light Quanta."* **V. S. Vrkljan.** (Zeits. f. Physik, 43. 7. pp. 516–518, 1927.)—Based on the method of an earlier paper [see Abstract 929 (1926)], the author shows how the equations $E = h\nu$ and $g = h\nu/c$ derived by Schaposchnikow [see Abstract 1996 (1927)] for light quanta relations in elliptic polarisation can be extended to the case of circular polarisation. H. H. Ho.

2675. *Wave Mechanics and Classical Mechanics and Electrodynamics.* **G. A. Schott.** (Nature, 119. pp. 820–822, June 4, 1927.)—Recent articles by Fowler, Born, and Jordan have dealt with the relation between Schrödinger's wave mechanics and the quantum theory, but it is admitted that they scarcely express the views of Schrödinger himself or those of de Broglie, and the object of the present paper is to give an account of the researches from the viewpoint of classical mechanics and electrodynamics. A brief bibliography is included. H. H. Ho.

2676. *Calculation of the Energy in a Simplified Problem of Four Bodies.* **K. F. Niessen.** (Zeits. f. Physik, 43. 9–10. pp. 675–693, 1927.)—The special case of the problem of four bodies in which two bodies are very massive compared with the other two is treated by means of classical theory as a preliminary to the treatment of the mechanics of the excited hydrogen molecule by quantum theory involving the introduction of half quantum numbers. J. S. G. T.

METEOROLOGY AND GEO-PHYSICS.

2677. *Geopotential and Height in Sounding with a Registering Balloon.* **N. Shaw.** (Roy. Meteorolog. Soc., Mem. 1. pp. 107–118, May, 1927.)—The author considers the thermodynamical diagram for the atmosphere is of considerable value. Details were given earlier of entropy-temperature diagrams and their special uses [Abstract 2446 (1925)], and these have been accepted by the International Commission for Investigation of the Upper Air and are in use in some of the principal meteorological institutes. A tephigram (temperature-log potential temperature diagram) is compared for the determination of the geopotential at any point and thence of the height. The total energy required to effect the change in the geopotential between two points consists of (1) the supply of heat necessary to keep the unit mass of ascending air in thermal equilibrium with its environment at each stage of the sounding, and (2) the dynamical equivalent in C.G.S. units of the heat which corresponds with the lapse of temperature of unit mass of air between the two points. These can be evaluated from the tephigram. Three special cases are examined, (1) isothermal atmosphere, (2) convective equilibrium for dry air, and (3) conditions where both temperature and entropy change. R. S. R.

2678. *The Presence of Solid Nitrogen in the Earth's Atmosphere.* **H. Pelzer.** (Ann. d. Physik, 83. 3. pp. 362–384, June 16, 1927.)—In the spectrum of the North light, a green line at 5577·35 Å. has been attributed by Vegard to the presence of solid nitrogen at high altitudes. By employing the radiation equilibrium equations derived by Schuster, Schwarzschild, and Emden, calculations are made of the equilibrium temperature of the stratosphere due to absorption from the earth and sun and the loss through emission. The different cases considered are when the absorption is uniform (grey) and when selective absorption occurs in the ultra-violet and in the infra-red. In order to attain the melting point of nitrogen (36° abs.), it is calculated that when acting as a grey body, the absorption in the lower atmosphere must be complete to within a fraction of 10^{-1430}, and with selective absorption in the infra-red to within 99·5 %. The hypothesis is therefore concluded on thermodynamical grounds to be untenable. J. N. P.

2679. *Meteorological Perturbations of Tides and Currents in an Unlimited Channel Rotating with the Earth.* **H. Horrocks.** (Roy. Soc., Proc. 115. pp. 170–183, June 1, 1927.)—The Liverpool Tidal Institute publishes graphs giving the residues when the predicted tide has been removed from the observed tide. The former is obtained by harmonic analysis of records extending over a long period, and should contain all important periodic terms occurring regularly and derived directly or indirectly from astronomical causes. Irregular features such as meteorological effects would not occur in the predictions, and should be important in the curve of residues. Thus the residual oscillations may be due to meteorological conditions over the Irish Sea generating a disturbance in the deep channel running north and south between St. George's Channel and the North Channel, and this being propagated over the shallow eastern waters of the Irish Sea. The general problem is investigated mathematically in the paper, the equations of motion in the channel being established and boundary conditions inserted. The cases considered are (1) disturbances generated by wind and atmospheric pressure varying only with distance from the sides of the channel and with time, (2) motions with no meteorological disturbance but an initial current system and surface elevation decay through the effects of turbulence. These lead to oscillations with a period and rate of decay similar to the results found directly at Liverpool. R. S. R.

2680. *Generalised Sturm-Liouville Expansions in Series of Pairs of Related Functions.* **H. Horrocks.** (Roy. Soc., Proc. 115. pp. 184–198, June 1, 1927.)—The expansions developed in the paper are required for the author's discussion of "Meteorological Perturbations of Tides and Currents in an Unlimited Channel Rotating with the Earth" [see preceding Abstract]. R. S. R.

2681. *Transmission of Distortional Waves.* **T. Matuzawa.** (Phys. Math. Soc. Japan, Proc. 9. 3. pp. 31–44, March, 1927. In English.)—The gravitational instability of the earth is examined on the assumption of a central core with a view to discovering whether distortional waves can be propagated through this core. The rigidity coefficient comes out about ten times that of elastic rubber, *i.e.*, very small in magnitude. If the earth were under a stable condition with material of such rigidity, it would be a difficult matter to identify distortional waves in the core. W. A. R.

2682. *Thermit and Icebergs.* **H. T. Barnes.** (Frank. Inst., J. 203. pp. 611–634, May, 1927.)—The experiments carried out with charges of thermit on icebergs [see Abstract 1671 (1927)] were extended to remove several large ice jams in the St. Lawrence and Allegheny Rivers during the winters of 1925 and 1926. The advantage of using this explosive is that no damage is caused to concrete or other structures or to fish in the rivers, because the explosion acts slowly. R. S. R.

2683. *Reduction of Acceleration Due to Gravity and the Law of Isostasy.* **H. Jung.** (Phys. Zeits. 28. pp. 377–383, May 15, 1927.)—The corrections which have to be applied to the local value of the acceleration due to gravity so that it may give a general value for use in physical questions is first considered, and in particular the effects of land masses near the station, and the height of the station above sea-level are dealt with. The Bouguer correction is discussed and also general considerations relating to the laws of isostasy. Finally, the effects of intrusions in the layers beneath the earth's crust in disturbing isostatic equilibrium are dealt with, and an example given to show the usefulness of the Niethammer method of calculating the correction. R. S. R.

2684. *External Gravitation Field and Earth-Crust Densities.* **M. Brillouin.** (Comptes Rendus. 184. pp. 1609–1613, June 27, 1927.)—Following a previous investigation [see Abstract 1833 (1925)] the author now gives a formula somewhat more determinate. The condition of isostasy (crust supported mainly by a hydrostatic pressure at a certain depth) can always be completely satisfied without getting rid of a large indeterminateness in the densities of the crust; but geodetic observations alone cannot solve the problem as to whether the equilibrium of the earth's crust is wholly, almost wholly, or not at all isostatic. A. D.

2685. *Nature and Origin of the Earth's Surface Structure.* **J. Joly** and **J. H. J. Poole.** (Phil. Mag. 3. pp. 1233–1246, June, 1927.)—H. Jeffreys, from observations on earthquakes, gives three layers for the earth: (1) Continental layer, depth 20–30 km.; (2) basaltic layer, depth 20 km.; and (3) layer probably of dunite extending downwards 1200 km. The evidence for these layers and their respective depths is examined from chemical analysis, mean densities, rates of thermal evolution, and Ra and Th content. For the lowest parts of the third layer facts in support of L. L. Fermor's view that eclogite, not dunite, is the mineral are emphasised. In tabulating the results obtained an increased density and decreased heat evolution is shown on proceeding downwards through the successive layers, continents, sub-oceanic basalt, sun-continental basalts, dunite, and eclogite. These were all originally in a heterogeneous state, but the greater heat evolution in the substances of greater radioactive content produced a decreased density, and a gravitational flow resulted to give finally the existing stratification. R. S. R.

ASTRO-PHYSICS.

2686. *Sunspots.* **G. E. Hale.** (Nature, 119. pp. 708–714, May 14, 1927.)—Tabulations of the directions of whirl, polarity and hemisphere for sunspots give results in favour of the cyclonic hypothesis. The underlying vortices apparently have opposite rotations in the two hemispheres and these directions are reversed at each sunspot minimum. A. Wh.

2687. *Electrical Charges of the Sun and Moon.* **W. Anderson.** (Zeits. f. Physik, 43. 8. pp. 591–596, 1927.)—Discusses the hypothesis of F. Sanford, that the sun and moon have large negative charges, and shows that this can only be possible if, near the surface of the sun, a phenomenon analogous to the Ramsauer effect occurs, owing to which the large electrostatic field acts very slightly indeed, if at all, on slow electrons [see Abstract 1313 (1927)], and if protons are converted into energy of radiation in the interior of the sun, thus constantly setting free new electrons. Both of these conditions are necessary for Sanford's theory to hold. H. N. A.

2688. *State of Motion in Galactic System.* **B. Lindblad.** (Roy. Astron. Soc., M.N. 87. pp. 553–564, May, 1927.)—The author assumes that the stellar system has a general rotational motion (retrograde) round an axis perpendicular to the galactic plane, in the direction of galactic longitude 330°, as has been derived from the "asymmetrical drift" of stellar velocities of great size. This "asymmetrical drift" implies a division of the stellar system into an infinite number of "sub-systems" of varying mean rotation speed, whose minimum internal velocity corresponds to greatest rotation speed. He suggests for the primitive stellar system a central mass and a flattened figure of rotational symmetry under "hydrodynamic" forces. Of this flattened figure, some parts will move in circular orbits in the equatorial plane and will constitute the most rapidly rotating sub-system; other parts, in orbits inclined to the plane, and matter will be ejected from the very flattened sub-systems. In this way smaller masses gain, in the mean, higher velocities relative to the rotating frame; they spread at right-angles to the galactic plane, and tend to lag behind the galactic system in rotation speed. He obtains a quantitative estimate of the relations between mean rotation speed and internal velocity dispersion, and finds that the different sub-systems have nearly the same extension in the galactic plane. Oort has found that the gravitational field near us may be governed by a central spherical mass (K_1) and an approximately spheroidal or a series of spheroidal distributions with the same centre and equatorial plane (K_2), with the ratio $K_1/K_2 = 0 \cdot 29$. The author takes it that K_2 is caused by a series of very flattened homogeneous spheroids of total mass M, and K_1 by a mass μM at the centre, finding $\mu = 4 \cdot 8$, thus indicating a considerable degree of concentration and "ordinary" stability with respect to mass motions, so that a clear spiral structure does not develop in our system. He finds the Kapteyn star-streaming in good accordance quantitatively with the general state of motion in the galactic system as given by his theory. A. S. D. M.

2689. *New Apparatus for Automatically Registering Radiotelegraphic Signals.* **P. Vocca.** (N. Cimento, 4. pp. 146–151, May, 1927.)—Describes, with illustrations, which should be studied in the original, a modified form of the apparatus which formed the subject of a recent paper. [See Abstract 1311 (1927).] E. F.

LIGHT.

2690. *Dependence of the Refractive Index of Gases on the Pressure between* 1 *and* 10 *Atmospheres.* **M. Opladen.** (Zeits. f. Physik, 42. 2–3. pp. 160–171, 1927.)—The function $(n - 1) = f(p)$ is investigated for air and carbon dioxide, using a Perot-Fabry interferometer in the pressure region between 1 and 10 atmospheres, and the constants in Mascart's relation $(n - 1) = Kp(1 + \beta p)$ are evaluated. The measuring of the higher pressures results in the adoption of a new method of pressure estimation. A. C. M.

2691. *Effect of Temperature on the Stress-Optical Behaviour of Glass.* **K. Okuda.** (Kyushu Univ. Coll. Eng., Mem. 4. 3. pp. 159–191, 1927.)—If glass is cooled while it is stressed and the stress is then removed, there remains a residual double refraction. In order to make clear the nature of the residual double refraction, two series of experiments were carried out. The first series was performed to determine the relation between the residual double refraction on the one hand and stress, temperature, residual strain, heating duration, etc., on the other. The second series was performed to observe the change of double refraction of glass (subjected to a constant stress) during heating and cooling. The residual double refraction decreased with the lapse of time after unloading. In view of these experimental results, the author considers the artificial double refraction of glass to be due to molecular orientation and molecular strain. AUTHOR.

2692. *Taylor's Photographic Lenses.* **A. Biot.** (Ann. Soc. Sci. de Bruxelles, 47. pp. 49–56, June, 1927.)—Revision of the formulæ for calculations. The general equations given and solved for thin lenses of powers ϕ_1, ϕ_2, ϕ_3 at distances d_1, d_2. The unknowns are expressed as functions of ϕ_2 the power of the negative lens; the equations are first solved for d_1, then for the others. For d_1 the equation is a cubic; a discussion of this. Then come approximate equations introducing corrections for the thicknesses of the lenses. The method may be readily adapted to other combinations of three lenses. A. D.

2693. *Optical Systems of Oscillograph and Similar Recording Instruments.* **A. C. Hardy.** (Optical Soc. America, J. and Rev. Sci. Inst. 14. pp. 505–516, June, 1927.)—The photometry of these systems is discussed and equations are derived permitting the ready calculation of the size of the spot, its maximum permissible velocity and its deflection for a given rotation of the mirror. For convenience the system where spherical lenses only are used is studied separately from that wherein a combination of cylindrical lenses is employed. All properly designed spherical lens systems, and this includes a single lens system, of which the diameter need not be larger than the greatest dimension of the mirror, are shown to be equally efficient when compared on the basis of equal deflections. With cylindrical lenses it is possible to obtain nine times as much light as with a spherical system. The effect of diffraction at the edge of the mirror is considered and is shown to result in an optimum value for the deflection, a result generally overlooked, for the present systems are proved to be very wasteful of light. A table is given of photographic brightness values for different sources of light, and this allows one to predetermine whether an optical system will provide sufficient illumination to leave a readable trace under any set of conditions. J. K.

2694. *Calculation of Optical Systems.* **M. Herzberger.** (Zeits. f. Physik, 43. 9–10. pp. 750–768, 1927.)—A theoretical treatment for which the original should be consulted. W. H. Gr.

2695. *Stationary Waves of Circularly and Elliptically Polarised Light.* **M. Katalinić.** (Ann. d. Physik, 83. 4. pp. 498–520, June 28, 1927.)—A solution is obtained for a plane monochromatic wave circularly polarised, passing through an isotropic homogeneous medium, falling perpendicularly on a plane mirror and being completely reflected. The conditions required for (1) a rotating and (2) a helicoidal stationary wave are obtained. Experimentally, reflection is not perfect and some of the light is scattered. Thus only a part arrives at normal incidence, some being circularly and the rest elliptically polarised. The influence of both is considered. From these theoretical considerations a system of nodes and antinodes is demonstrated whose positions should be independent of the kind of light used. Full details are given of the experimental methods used. The existence of nodal lines was confirmed but the experiments on helicoidal waves frequently gave no results because of the experimental difficulties. This confirms the idea that the electric vector is independent of the path of the magnetic vector. R. S. R.

2696. *Polarisation of the Light from Hydrogen Canal Rays.* **K. L. Hertel.** (Phys. Rev. 29. pp. 848–856, June, 1927.)—Light from hydrogen canal rays (principally Hβ) was found to be partially polarised, with the electric vector of the stronger component in the direction of motion of the particles. The amount of this polarisation varied over a considerable range; the maximum polarisation observed was about 10 %. Measurements at different positions along the canal ray bundle show that the polarisation dies away more rapidly than does the intensity. Its half-value time is about one-third that for the intensity. When an electric field at right angles both to the canal ray bundle and to the direction of observation is applied to the canal rays the polarisation changes rapidly (in less than 10^{-9} sec.) at the points of entry to and exit from the field. The change is in the same direction at both entry and exit and is such that the component of the electric vector perpendicular to the direction of motion is increased relative to the parallel component. The change increases with the strength of the field up to 300 or 500 volts per cm., after which the increase is small. In a weak uniform field (less than 200 volts per cm.) the polarisation appears to die out at about the same rate as with no field. In stronger uniform fields there is a tendency for the light to become polarised with the stronger component of the electric vector in the direction of motion. There is some evidence of periodicity in the polarisation as the particles pass through a uniform field. A. D.

2697. *Effect of Wave-Length on the Differences in the Lags of the Faraday Effect behind the Magnetic Field for Various Liquids.* **F. Allison.** (Phys. Rev. 30. pp. 66–70, July, 1927.)—The lag of the

Faraday effect behind the magnetic field was measured by the method of Beams and Allison [see Abstract 1337 (1927)] in carbon bisulphide, toluene, carbon tetrachloride, benzene, xylene, chloroform, and bromoform for various wave-lengths of light from 4481 to 5896 Å. It is found in every case that the difference in the lags of the Faraday effect behind the magnetic field increases as the wave-length of the light decreases. The extreme magnitudes observed in these time-lag differences range from $0 \cdot 2 \times 10^{-9}$ sec. for the longest wave-lengths to $12 \cdot 2 \times 10^{-9}$ sec. for the shortest, depending upon the two liquids compared. The precision is about $0 \cdot 2 \times 10^{-9}$ sec. Observations made on carbon bisulphide, toluene and chloroform failed to detect any effect of temperature on the lag of the Faraday effect for temperature differences of 40° C. The method of the experiment affords a means of measuring the ratio of the speed of electric impulses along copper wires to the speed of light. The value obtained for the ratio was about 96 %. AUTHOR.

2698. *Rotatory Power of Aqueous Electrolytes as Affected by the Concentration and Activity of Hydrogen Ions.* **(Miss) J. Liquier.** (Ann. de Physique, 8. pp. 121–203, July–Aug., 1927.)—The variations of rotatory power and the anomalous rotatory dispersion of solutions of asparagine can be explained by the presence in acid and basic solutions of two of the following three components:—

Kation $\mathrm{HO.CO.CH(CH_2.CO.NH_2).\overset{+}{N}H_3}$

Neutral molecule or "zwitterion"

$\mathrm{HO.CO.CH(CH_2.CO.NH_2).NH_2}$

or $\mathrm{\overset{-}{O}.CO.CH(CH_2.CO.\overset{+}{N}H_2).NH_3}$

Anion $\mathrm{\overset{-}{O}.CO.CH_2(CH_2.CO.NH_2).NH_2}$.

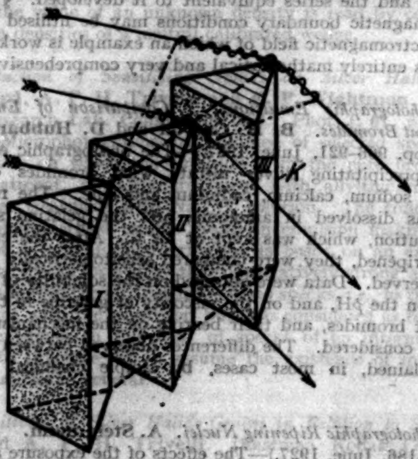
The "neutral molecule" is lævorotatory, and its lævorotation is increased when a hydrogen ion is removed from the carboxyl-group by the action of a base; but when, on the other hand, a hydrogen ion is added to the amino-group by working in presence of an acid, a reversal of signs occurs which makes the component strongly dextrorotatory with a "simple" rotatory dispersion. A study of their optical-rotations indicates that solutions to which salts have been added owe their optical activity to the same three components. [See also Abstract 2581 (1927).] T. M. L.

2699. *Scattering of Light in Water Spray.* **G. I. Pokrowski.** (Zeits. f. Physik, 43. 9–10. pp. 769–772, 1927.)—Further measurements given [see Abstract 2495 (1927)]. The results are in harmony with Wiener's calculations as well as with the Rayleigh-Mie theory. A. D.

2700. *Remarks on the Quantum Theory of Diffraction.* **P. Ehrenfest** and **P. S. Epstein.** (Nat. Acad. Sci., Proc. 13. pp. 400–408, June, 1927.)—Before attacking the Fresnel problems, the authors restate some of the considerations of their last paper [see Abstract 1812 (1924)] dealing with the Fraunhofer diffraction in a new form suitable for generalisation. It is shown that electronic density can always be built up by a superposition of a three-fold infinity of sinusoidal elementary lattices.

The Fresnel diffraction from the classical point of view is then considered, and it is shown that in the act of reflection from the ellipsoidal lattice there prevails a transformation of momentum quite similar to that discovered by Duane for the plane lattice. Interpretation is then given in terms of light quanta. Finally, limitations of the theory are discussed, when it becomes clear that the phenomena of the Fresnel diffraction cannot be explained by purely corpuscular considerations, but that it is necessary to attribute to the light quanta properties of phase and coherence similar to those of the waves of the classical theory. H. H. Ho.

2701. *Interference Bands Due to a Series of Prisms.* **C. Hummel.** (Ann. d. Physik, 83. 4. pp. 575–608, June 28, 1927.)—Investigates the prism system shown in the figure. The experimentally determined positions of the interference bands agree well with those calculated. The system can be used for investigating the fine structure of spectral lines. J. W. T. W.



2702. *Diffraction Phenomena at Bodies of Ellipsoidal Form.* **F. Möglich.** (Ann. d. Physik, 83. 5. pp. 609–734, July 11, 1927.)—Part I of this paper deals in fourteen sections with the integration of equations of oscillation in elliptical coordinates: § 1 derives from the usual elliptical coordinates γ, υ, ν, another type which satisfy the Laplace differential equations and which physically correspond to potentials of surfaces of the second order. § 2 gives the form which the oscillation equation takes in these coordinates, and special integrals are sought which are products of three simple functions, each of which depend only on one of the three coordinates α, β, and ν. From this result three ordinary differential equations of the second order and same form are obtained in § 3 for the three functions. These involve six arbitrary constants which are reduced to two by the equivalence of the three differential equations to the oscillation equation. In § 4 the general integral of the wave equation is obtained; and §§ 5–9 consider the details involved leading to eight types of convergent series. In § 10 the Ritz process is applied to the main differential equation, and its special values (Eigenwerte) all found to be simple. § 11 derives series in cylindrical functions which give precise expressions for the behaviour of the above functions at infinity §§ 12 and 13 give integrals which find application in the derivation of the diffraction wave; and § 14 treats the special case of the presence of an axis of symmetry in the coordinate system.

Part II considers the diffraction problem. In § 15 it is shown how the coordinate system may be derived from the form of the diffracting ellipsoid and which particular equation the latter satisfies. The Hertz vector is introduced as the integral of the Maxwell equations and the general integral of the wave equation stated, transformed into elliptical coordinates, and the series equivalent to it developed. § 16 shows how the electromagnetic boundary conditions may be utilised for evaluating a special electromagnetic field of which an example is worked out in § 17. The paper is entirely mathematical and very comprehensive. H. H. Ho.

2703. *Photographic Emulsions. I. Comparison of Emulsions made with Different Bromides.* **B. H. Carroll and D. Hubbard.** (J. Phys. Chem. 31. pp. 906–921, June, 1927.)—The photographic emulsions were made by precipitating silver nitrate with bromides of potassium, ammonium, sodium, calcium, cadmium and zinc. The resulting silver bromide was dissolved in ammonia, and the gelatine soaked in the bromide solution, which was kept at 45° C. After the emulsions were mixed and ripened, they were compared sensitometrically and the grain size was observed. Data were obtained on the solubility of the unwashed emulsions, on the *p*H, and on the viscosity of gelatine in the presence of the different bromides, and their bearing on the mechanism of emulsion making was considered. The differences observed between the emulsions can be explained, in most cases, by simple chemical and physical principles. F. J. B.

2704. *Photographic Ripening Nuclei.* **A. Steigmann.** (Kolloid Zeits. 42. pp. 183–186, June, 1927.)—The effects of the exposure and growth of the ripening nuclei are, according to the experiences of colloid chemistry: (1) Their enhanced catalytic efficiency in light and in the developer. (2) Changes in the light absorption because, according to Mie [see Weigert, Kolloid Zeits. 28. p. 154 (1921)], with diminishing dispersity the absorption of the ripening nuclei is shifted towards the longer waves. (3) Increased liability of the exposed nuclei to attack by oxydisers. *Causes of formation of ripening nuclei.*—Recent publications show that it is due to thiocarbamides, cystin, and the alkaline, fermentative and photochemical decomposition products of substances containing cystin. It may be assumed, on the basis of various facts, that the sensitising sulphur bodies are first absorbed and then decompose, chiefly under the influence of heat, with formation of silver sulphide nuclei. *Growth.*—The various factors involved are discussed at some length. It may be said, briefly, that the nuclei formed on the fine grain of an emulsion are very numerous, highly dispersive and partly rendered inactive by absorption, while those on the coarse grain are relatively of low dispersive power and small number and their catalytic properties less affected. When, therefore, ripening sets in (formation of SH̶ ions, labile hydrogen and

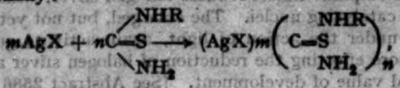
Ag ions), the nuclei grow much more rapidly on the coarse than on the fine grain. Excessive growth leads to fogging, especially on coarse grain emulsions. *Hydration theory of secondary ripening and of the formation of the latent image.*—In the process of ripening, the hydrogen activated by the silver sulphide nuclei reduces halogen silver, which settles on and enlarges the catalysing nuclei. The enlarged, but not yet fully developed, nuclei will, under the action of light, again activate gelatine-hydrogen, thus once more effecting the reduction of halogen silver and overstepping the threshold value of development. [See Abstract 2586 (1926).] E. F.

2705. *Density Comparator* (*Photography*). **W. B. Ferguson.** (Phot. J. 67. pp. 278–280, June, 1927.)—A simplified Ferguson comparator described in which there are no photoelectric cells or galvanometers, and in which the value of an unknown density is read by comparing it with the known densities of a neutral calibrated wedge. A. D.

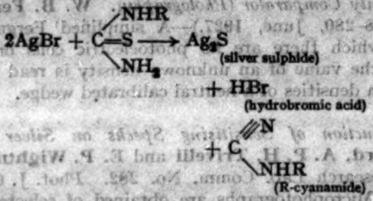
2706. *Production of Sensitising Specks on Silver Halide Grains.* **S. E. Sheppard, A. P. H. Trivelli** and **E. P. Wightman.** (Eastman Kodak Co. Research Lab. Comm. No. 282. Phot. J. 67. pp. 281–283, June, 1927.)—Microphotographs are obtained of selected spots on one-grain-layer plates on which the emulsion is of the pure bromide type, (*a*) before treatment, (*b*) after treatment with allylthiourea solution, (*c*) after further treatment with Na_2CO_3 solution. The conclusion that the silver sulphide formed on the grains in emulsion making exists as specks and not as a uniform distribution is based on an extrapolation from the visible specks formed by the comparatively strong action of the sensitiser and alkali to the zero condition of no specks, *i.e.*, to the condition before treatment with the sensitiser, but it is considered as reasonable to suppose the existence in this case of specks of an intermediate size, which would be invisible, as to assume the existence of invisible sub-microscopic particles in general. A. B. C. L.

2707. *Sensitivity of Silver Halide Grains in Relation to Size.* **S. E. Sheppard** and **A. P. H. Trivelli.** (Eastman Kodak Co. Research Lab. Comm. No. 298. Phot. J. 67. pp. 284–287, June, 1927.)—The results of the investigations of the effects on sensitivity of the grain size of emulsions by Renwick and others [see Abstract 1255 (1921)] are briefly summarised, and experiments are carried out with the object of checking these results using emulsions of pure AgBr. It is found that to α-particles, large grains appear to be inherently more sensitive as a purely statistical effect of projective area or target size. It is shown that a greater proportion of iodide is not a necessary condition for relative greater sensitivity of large grains, but no indication is afforded as to the reason. A. B. C. L.

2708. *Addition Compounds of Allyl-Thiourea with Silver Halides.* **S. E. Sheppard** and **H. Hudson.** (Eastman Kodak Co. Research Lab. Comm. No. 303. Phot. J. 67. pp. 331–335, July, 1927.)—In an investigation on photographic gelatine [see Abstract 2270 (1925)] it was found that the photographic activity of certain gelatines depends upon the presence of traces of mustard oil, or allyl-isothiocyanate, and the thiourea (allylthiocarbamide, thiosinamine) derived therefrom. Further, it was shown that this photographic sensitising power was a general property of thioureas and a number of cognate bodies, being due to the formation of small traces of silver sulphide in the silver halide grains. These traces of silver sulphide were considered to constitute the so-called sensitivity centres of photographic theory. The chemical reactions in this sensitising process are essentially:

(I)


where *m* and *n* are simple integers.

(II)


In stage (II) sufficient alkalinity is necessary to neutralise the hydrobromic acid and the cyanamide. The present investigation is concerned with the formation and properties of the intermediate double compounds of silver halide and thiourea indicated in (I). The following are the points dealt with: Silver chloride and thiosinamine; silver bromide and thiosinamine; silver iodide and thiosinamine; effect of soluble halides; composition and constitution; relation to photographic sensitising.

A. E. G.

2709. *Contribution to the Knowledge of the Latent Image.* **J. Eggert** and **J. Reitstötter.** (Zeits. Wiss. Phot. **24.** pp. 350–361, July, 1927.)—The action of solutions of methylene blue of known concentrations upon the forming and latent image was investigated. The effect of the methylene blue on the chemical and physical development before fixing was determined. It was found that the dyestuff influenced the forming of the latent image, but was without effect on the formed image. It was deduced that the silver existed in a more dispersed state during the formation of the latent image than in the final state. A comparison of the number of active methylene blue molecules to each silver bromide nucleus and to the number of silver atoms liberated by the light, led to the new theory of the coagulation of the latent image. This theory ascribes to the silver atoms the power of collecting at certain nuclei, which are the result of external (*e.g.*, adsorptive) causes, and which do not coincide with the positions of definite absorption of light. F. J. B.

2710. *Microphotography of Opaque Objects at Low Magnifications.* **F. Kahler.** (Zeits. Wiss. Phot. **24.** pp. 361–366, July, 1927.)—The microphotography of opaque objects at low magnifications requires the use of object glasses which have a greater depth of focus than the highly corrected object glasses in use for greater magnification. A method of photographing small opaque objects was worked out, based upon the principle that when an object is placed beyond the double focal length from a positive lens, an inverted, diminished, but real image of the object is obtained. This image can then be magnified by another lens or by the microscope. The condenser or a low-power object glass can be used for the first lens, and the magnification effected by suitable object glasses. A good high candle-power illuminant must be used, and the optical system must be centred. The exposure was done in two stages, with different times and voltages to avoid the picture becoming fuzzy when shiny objects were being photographed. The method does not give such good results as can be obtained with special object glasses, but it enables good results to be attained with the ordinary equipment of the microscopist. F. J. B.

2711. *Calculation of Exposure Time in Photography.* **B. Schultze-Naumburg.** (Zeits. Wiss. Phot. 24. pp. 385–390, July, 1927.)—Gives rules for determining the values of the various quantities in the formula: exposure time = (const. of plate)/(reflection factor × illumination). In particular figures are given for the constants of various plates, and average values of the illumination at different times of the day and different months are given in the form of a graph. J. W. T. W.

2712. *Flash Light.* **H. Beck** and **J. Eggert.** (Zeits. Wiss. Phot. 24. pp. 367–379, July, 1927.)—Methods of measurements described. One gramme of Agfa flash-light mixture at 1-metre distance gives a maximum intensity of $1 \cdot 2 \times 10^6$ Hefner candles, a total energy of $6 \cdot 9 \times 10^4$ MKS, a total period of combustion of 0·183 second and a practically utilisable period of illumination of 0·106 second. A. D.

2713. *Fading of Fluorescence in Solid and Liquid Solutions.* **W. L. Lewschin.** (Zeits. f. Physik, 43. 3–4. pp. 230–253, 1927.)—By "fading" is meant the decrease in the ratio emission/absorption with increasing concentration. A discussion of the existing investigations, theoretical and practical, is given [see also Abstracts 2261 (1924), 1638 (1925) and 2834 (1926)], and it is concluded that no theory is in satisfactory agreement with the results. Then follows an account of the author's observations on rhodulin and fluorescein in solid sugar. Fading follows the same course as in liquid solutions. Spectral and temperature investigations are given. The author regards fading as due to several causes—the solvent molecules in a dyestuff solution do not form part of the centres, but may affect adversely the power of the dye molecules to fluoresce; further, the solvent molecules may have a shielding effect which varies with the concentration. He considers that the development of a quantitative theory needs further experimental results. J. E.

2714. *Impact Fluorescence of Zinc.* **J. G. Winans.** (Phys. Rev. 30. pp. 1–10, July, 1927.)—Excitation of the zinc spectrum by collisions of the second kind with excited mercury atoms.—A sealed quartz tube containing zinc vapour at 16·0 mm. and mercury vapour at 0·28 mm. was illuminated by light of various wave-lengths from the hot and cold quartz mercury arcs and the aluminium spark. The resulting fluorescent radiation, observed with a short-focus quartz spectrograph, contained several zinc lines which required more than 4·9 volts for their excitation. To account for these lines it is necessary to assume that mercury atoms in the 2^1P_1 and 2^3S_1 or 3^3D states are effective in impacts of the second kind. 2^1P_1 mercury atoms (energy 6·67 volts) were found to excite the first triplet of the sharp series of zinc requiring 6·62 volts, but not the resonance line 3075, which requires 4·01 volts. This indicates that a collision between an excited mercury atom and a normal zinc atom is more likely to be one of the second kind if the energy of the excited mercury atom only slightly exceeds that needed to excite the zinc atom. A band, probably due to HgZn, formed in the excited state or excited by an impact of the second kind, was also observed in the fluorescent light. [See Abstract 1314 (1926).] AUTHOR.

2715. *Measurement of the Duration of the Luminosity of the Atom.* **H. Kerschbaum.** (Ann. d. Physik, 83. 2. pp. 287–295, June 8, 1927.)—In this paper measurements are recorded for the duration of luminosity of the alkaline earth metals, calcium, strontium and barium. Differences between the spark lines were found and their electrical deviations investigated. Tables of data are included. H. H. Ho.

2716. *Frequency Changes of Light and Quantum Theory.* **G. Breit, A. E. Ruark** and **F. G. Brickwedde.** (Phil. Mag. 3. pp. 1306–1314, June, 1927).—On the classical wave theory a monochromatic train of waves ceases to be monochromatic when interrupted, *e.g.*, by a mechanical shutter. This may be explained on the quantum theory from two points of view, both assuming that the interrupting mechanism may contribute to the energy of the quantum passing through it. The first explanation suggested pictures the interrupting mechanism as first absorbing and then re-emitting the quantum; this view would account for the observed frequency change, as is shown with respect to Righi's experiments with rotating Nicols. Those experiments are, however, frequently misunderstood. His results were due to a peculiar averaging-out effect in the action of the quarter-wave plates, and are not directly connected with the fundamental equation of the incident light frequency and the frequencies of the two transmitted waves $\nu \pm N$. The second explanation considers the interrupting apparatus and the emitting atom as one complex, generalised atom. Rays of different frequencies may be coherent, as in Righi's experiments, and the authors' treatment differs from that of Compton by the importance attached to coherent wave-trains. H. B.

2717. *Production of the Continuous Spectrum of Mercury.* **Duffieux.** (Comptes Rendus, 184. pp. 1434–1436, June 13, 1927.)—A large drop of mercury, 6 cm. in diameter, was enclosed in an evacuated spherical bulb. The appearance of the drop at various speeds of rotation of the bulb and at various temperatures is described. At a little above 50° the green and violet lines could be seen in the spectrum of the discharge excited by the frictional electricity produced, while at 120° all the arc lines are emitted and also a feeble continuous spectrum. F. S.

2718. *Relative Intensities of Some Lines in the Mercury Spectrum.* **J. Valasek.** (Phys. Rev. 29. pp. 817–821, June, 1927.)—Intensities of the most intense spectrum lines associated with transitions to and from the $2p_2$ state in mercury were measured by means of a photographic method. The spectrum of the vapour was excited by electron impact above the ionisation potential. Variations in the line intensities due to changes in the accelerating potentials and vapour pressures were observed. At 22° C. and with 50-volt electrons there were about $1 \cdot 7 \times 10^{12}$ quanta of λ2537 radiation emitted per cubic centimetre per second for a current density of $4 \cdot 75 \times 10^{15}$ electrons per square centimetre per second. From the intensities of the other lines relative to λ2537, it was found that there are apparently more transitions to $2p_2$ than down from $2p_2$, as given by measurements of the radiation. This made it impossible to determine the probability of excitation of resonance from the intensities of the spectrum lines. A comparison is made between the relative intensities in the experimental tube and in a commercial arc. AUTHOR.

2719. *Continuous and Band Spectra of Mercury.* **H. Volkringer.** (Comptes Rendus, 185. pp. 60–62, July 4, 1927.)—In this continuation of previous work [see Abstract 1010 (1927)] the continuous spectrum as far as 2537 Å. has been compared with that of a tungsten filament lamp by means of a registering microphotometer. A maximum intensity is observed at about 0·336 μ which is approximately four-thirds of the wave-length of the resonance lines. Previously the visible maximum had been found to be about the double of this value. This agrees with Kapuscuiskis' values for cadmium. A list of band-maxima from 3054 to 2681 Å. is also given. F. S.

2720. *Structure of a Class of Absorption Spectra.* **R. Ritschl.** (Zeits. f. Physik, 42. 2–3. pp. 172–210, 1927.)—The absorption spectrum of chromyl chloride is arranged in five Deslandres series and the formulæ calculated. The band spectra of four copper halides are obtained and the edges measured. The dependence on temperature of the system is investigated and the structure of the different groups compared. The copper iodide bands give a comparison with the emission-bands (Mulliken). Certain spectra give isotope effects in the vibration term, and show the calculated separations with fair accuracy. Many bands are shaded towards the red. In copper fluoride the groups run towards the violet. A. C. M.

2721. *Absorption of Quartz and Quartz Glass below* 4·1 μ. **T. Dreisch.** (Zeits. f. Physik, 42. 5–6. pp. 426–427, 1927.)—The bands of quartz near 2·9 μ show three maxima at 2·91, 2·97 and 3·02 μ. In the place of these bands, quartz glass shows a narrow single band at 2·75 μ which is very intense. Quartz and quartz glass give a narrow band at 3·75 μ. A. C. M.

2722. *Relation between the Absorption Spectra and the Chemical Linking of the Vapours of Alkali Halides.* **J. Franck, H. Kuhn** and **G. Rollefson.** (Zeits. f. Physik, 43. 3–4. pp. 155–163, 1927.)—The absorption spectra of several alkali halides are investigated. The photochemical dissociation processes are observed in order to obtain some knowledge of the condition and structure of the molecules. The generalisation follows that a molecule which is made of two univalent ions may be broken up into two normal atoms or into a normal and an excited atom. The writers disprove the first possibility. A. C. M.

2723. *Absorption Spectrum of Bromine in Solution.* **Bovis.** (Comptes Rendus, 185. pp. 57–59, July 4, 1927.)—The effect of various solvents is discussed from the point of view of purity and permanence of the solution. Absorption maxima are found at about 0·414 μ and 0·260 μ.

The former has been found for gaseous and liquid bromine, but the latter in solution only. The region of transparency between $0\cdot340\,\mu$ and $0\cdot250\,\mu$ for liquid bromine has been explored quantitatively. F. S.

RADIOACTIVITY.

2724. *Theory of Luminescence in Radioactive Luminous Compounds.* **J. W. T. Walsh.** (Phys. Soc., Proc. 39. pp. 318–333; Disc., 333, June, 1927.)—Previous work on this subject is reviewed, and the results of brightness measurements on zinc sulphide compounds containing radium are given for periods up to 4000 days. From a comparison of the brightness curves of compounds made with the same luminescent material but with different radium concentrations it is shown that the brightness-time relationship is of the form $B = rf(rt)$, where r is the radium content. The experimental facts available for developing and testing a theory of the luminescence are summarised, and a number of different theories, including a modified form of the recovery theory, are considered. Finally, it is shown that the observed brightness curves are in excellent agreement with Rutherford's original theory of the destruction of active centres, provided this be combined with a simple hypothesis as to the cause of the progressive increase in the light absorption of the material which has been found experimentally. This leads to the following form of the brightness-time relationship: $\log\{B/(b + B)\} + kt + a = 0$, where a, b and k are constants, of which the last two are proportional to the radioactive concentration for any given grade of luminescent material. From the results obtained on two grades of compound it is concluded that (*a*) the rate of destruction of active centres is six to nine times that of the ionisation of inactive molecules, and (*b*) in the new material used for the compounds measured 20 to 50 % of the molecules are in the active state. AUTHOR.

2725. *Radioactivity of Matter after Long Exposure to Solar Radiation.* **(Miss) S. Maracineanu,** with a note by **H. Deslandres.** (Comptes Rendus, 184. pp. 1547–1550, June 20, 1927.)—In a recent paper Miss Maracineanu has described experiments made on the lead roof of the Paris Observatory; she has now investigated a piece of the lead in the laboratory, and finds that the surface which was not exposed to sunlight is not radioactive, while what was originally the upper surface had the same radioactivity as before, this, however, diminishing from day to day in the dark. No radioactivity was found in the upper surface of a piece of limestone taken from a point at the side of the lead roof. Lead from a cornice on the north side of the building, screened from direct sunlight, showed small radioactivity. A piece from a zinc and one from a copper roof were also tested; both showed distinct radioactivity in the upper surface, though less than for lead. In the case of zinc the lower surface was also feebly radioactive; the radiations from this metal are more penetrating than from the others. H. Deslandres considers that the observations indicate a special action of solar radiations, and suggests that the radioactivity observed in the lead from the north cornice may be due to the very penetrating X-radiation observed by Kohlhörster and by Millikan, which may be of cosmic origin. H. N. A.

HEAT.

2726. *Note on the Different Modifications of the Kohlrausch Method for the Determination of the Conductivity Relationships of Metals.* **H. Diesselhorst.** (Ann. d. Physik, 83. 2. pp. 303–304, June 8, 1927.)—In his paper on the heat conductivity of gas, Weber [see Abstract 1786 (1927)] criticised the method of the author which was applied to thick rods. The present note points out the identity of fundamental principles in the methods of Weber and the author without, however, claiming identity in procedure for varying cases. H. H. Ho.

2727. *Hydrodynamics and the Kinetic Theory of Gases.* **Y. Rocard.** (Ann. de Physique, 8. pp. 5–120, July-Aug., 1927.)—The treatise is divided into five parts. In the first section the classical method of development of the equations of motion of a perfect gas is considered on the kinetic theory. The equations are written in explicit form, adopting the results obtained by S. Chapman and by Jones. To a first approximation the equations of a viscous fluid are obtained. An analagous study is made of gaseous mixtures, a new term marking the influence of variations in composition being discussed. The second part deals with the hydrodynamics of compressed gases on the kinetic theory. Rigid elastic molecules are assumed as in the case of the gas of van der Waals. The equation of state of gases is discussed, and further approximations made by the method of statistical entropy. The third part gives an analysis of new terms which appear in the equation of motion of compressed gases, these new terms dealing with motions due to intermolecular forces and to impulses in the collisions. The former give precisely the combinations $\partial P/\partial x$, $\partial P/\partial y$, $\partial P/\partial z$ of the classical hydrodynamics; the latter give a correction to the coefficient of viscosity as a function of the specific volume. The equation of heat transfer is considered in the fourth section, and a rigorous expression for the thermal conductivity as a function of the specific volume is obtained. In the fifth section the results obtained are compared with certain experimental data. T. B.

2728. *Theory of the State of Matter. Part VIII. Internal Pressure and Theorem of Corresponding States.* **F. Schuster.** (Zeits. Elektrochem. 33. pp. 244–245, June, 1927.)—On ascending a homologous series, *i.e.*, with rise of the critical temperature, the temperature coefficient of the internal pressure diminishes, but the critical temperature alone does not determine the magnitude of the decrease. In passing from $n-C_6H_{14}$ to C_6H_{12} and C_6H_6, which have similar critical temperatures, new influences come into action. More marked differences still appear when compounds differing more greatly in type, such as alcohols and esters, are compared. These apparent irregularities may be removed by taking into account also the critical pressure, which for associated substances is comparatively high and runs parallel to the internal pressure. Moreover, with equal critical temperatures, compounds capable of exerting secondary valencies, such as esters, exhibit higher values of the critical pressure, internal pressure and its temperature coefficient (apart from the sign) than those possessing little or no field of residual force, like the paraffins. Thus, compounds of similar critical temperatures are separated into certain groups which may differ also chemically. T. H. P.

2729. *A New Equation for the Distribution of Radiant Energy.* **G. N. Lewis.** (Nat. Acad. Sci., Proc. 13. pp. 471–476, June, 1927.)—In a previous paper [Abstract 2339 (1927)] an equation was deduced for the entropy of radiation as a function of energy density and frequency, and proves to be identical with that of Planck. The present paper extends this work to show that there are many states of radiation in thermal equilibrium which are not included in the classical thermodynamics of radiation, and that in these states the distribution of radiant energy with respect to frequency may be considered by similar methods to those already employed. It is shown that Planck's formula can be regarded as a particular case of a more general equation, and that a generalised form of the Wien equation may be regarded as the universal law of radiation at low densities. S. G. B.

2730. *Factorial Functions in Entropy Calculations.* **M. Masius.** (Phys. Rev. 30. pp. 84–86, July, 1927.)—In entropy calculations in connection with the kinetic theory of gases or the quantum theory, the changes in functions depending on factorials have hitherto been calculated by a method depending on the replacement of factorials by continuous functions and differentiation. This method is neither simple nor logically satisfying. A new method of calculation is shown which depends on the direct evaluation, by simple well known processes, of $\Delta F = F(x + \Delta x, y + \Delta y, \ldots) - F(x, y, \ldots)$, where F is a function involving the factorials of $x, y, \ldots$, and where $x, y, \ldots$ and $x + \Delta x, y + \Delta y, \ldots$ are taken as integers. The details of this method are illustrated by the treatment of two examples. AUTHOR.

2731. *Binary Mixtures of Volatile Liquids with One Partially Associated Component.* **F. Michaud.** (Comptes Rendus, 184. pp. 1643–1645, June 27, 1927.)—A theory based on thermodynamic principles, involving the application of the formula of Duhem-Margules and the differential equation of mass action, is developed which provides a means of studying the dissociation of volatile substances. The substance is mixed with a normal liquid, preferably chosen to yield isotherms as nearly rectilinear as possible, and the formulæ obtained according to the theory are used to calculate, from the isotherms of the vapour pressure of the mixture and the corresponding compositions of the distillates, the partial pressures of the free and of the associated molecules. A. B. C. L.

2732. *Experimental Basis of the Third Law of Thermodynamics and its Generalisation.* **N. v. Kolossowsky.** (Zeits. f. Physik, 43. 7. pp. 509–511, 1927.)—Keesom [see Abstract 2647 (1926)] has recently shown that the rapid decrease of vapour pressure with declining temperature, observed for many individual substances, is a general phenomenon. The present investigation shows that the Nernst heat theorem, as also its generalisation for all states of aggregation, can be derived from the experimental formula $(dp/dT)_{T=0} = 0$. H. H. Ho

SOUND.

2733. *Partials of Tuning Forks.* **S. Idei.** (Tohoku Univ., Sci. Reports, 16. pp. 437–446, May, 1927. In English.)—Deals with Anderson's stem overtone, which is shown to be due to vibration as a free-free bar with two internal nodes, having, as the whole length, the distance from the tip of the prong to the tip of the stem. It is essentially the same as Quix's *stabton*. Some observations are also given on Edelmann's *plattenton* and on combination tones. W. H. Ge.

2734. *Distortion of Resonance Curves of Electrically Driven Tuning Forks.* **E. Mallett.** (Phys. Soc., Proc. 39. pp. 334–358; Disc., 358, June, 1927.)—A detailed experimental and theoretical treatment. The experiments deal with arrangements to obtain accurate resonance curves, free fork experiments in which the frequency is studied by Lissajous figures and the damping by photographic decay curves and static experiments on the mechanical stiffness of the fork and on flux alterations with deflection. The theory shows the importance of the term depending on the *cube* of the amplitude, and its inclusion gives resonance curves of the form observed. The effect of the static square term is shown to be in effect a dynamic cube term. The possibility of producing fundamental frequency vibrations in the fork by means of exciting currents of double frequency is demonstrated and the effect of a first harmonic in an exciting current of fundamental frequency is considered. Distortions of a second type are shown to consist of "coupled circuit" effects; these at large amplitudes are modified by distortions of the first type. In the *Discussion*, **A. Campbell** pointed out analogies with strip vibrators used as reeds. W. H. Ge.

2735. *Variation of the Velocity of Sound in Gases with Temperature.* **E. J. Irons.** (Phil. Mag. 3. pp. 1274–1285, June, 1927.)—Formulæ of various types are examined with reference to the accuracy with which they can be employed to express the velocity of sound in gases at various temperatures, using the experimental results obtained by Partington and Shilling, and others, in their investigations of the variation of the ratio of the specific heats of gases with temperature. An equation of the type $V = a + bT^n$ appears to be of interest in that the values of the constants obtained by two methods for the same gas are in good agreement. The value of n appears to be connected with the complexity of the molecule of the gas. A. B. C. L.

2736. *The Plane Wave in a Gas.* **S. Ray.** (Phys. Rev. 29. pp. 892–893, June, 1927.)—In a former paper [see Abstract 2914 (1926)] it was pointed out that the velocity of a transverse wave along a string is not independent of the amplitude and that for different frequencies to travel with the same velocity the ratio a/λ must be constant, as for light waves. The same result is here proved for plane longitudinal waves in air. Author.

2737. *Propagation of Sound in Bessel Horns.* **C. R. Hanna.** (Frank. Inst., J. 203. pp. 849–851, June, 1927.)—Discussion of a previous paper [see Abstract 1476 (1927)].—For Bessel horns having the shape $A = bx^n$ as n increases without limit the shape of the Bessel horn approaches that of the exponential horn. " The work of Ballantine, if rightly interpreted, gives further evidence of the superiority of the exponentially shaped horn." Reply by **S. Ballantine** (*ibid.*, pp. 852–853). W. H. Ge.

2738. *Pressure of Sound Waves on Resonating Bodies.* **W. Thomas.** (Ann. d. Physik, 83. 2. pp. 255–283, June 8, 1927.)—The sound pressure on a membrane and on an air resonator has been investigated experimentally by G. Hippe [see Abstract 1473 (1927)]. The theories of these two cases are developed here, and are found to agree favourably with the experimental results. In the first case the law of the dependence of the pressure on the distance of the membrane from the source only assumes the simpler, inverse square, form when the distance amounts at least to several wave-lengths. The conditions governing the attraction and repulsion of the resonating bodies are discussed. G. E. A.

2739. *The Directional Effect of Sound Sources.* **H. Stenzel.** (Elek. Nachrichten. 4. pp. 239–253, June, 1927.)—The paper deals mathematically with the variation of sound intensity with the direction of the sound rays. The "characteristic" of a source is defined as the manner of the variation of the amplitude of the maximum pressure with the direction of the sound. In the first part, the case is investigated of a number of point sources in line. The transition is made to a source which is not small compared with the wave-length by taking an infinite number of point sources. The second part deals with surface sources of the membrane type. A stretched circular membrane with given amplitude has the same deformation volume as a rigid piston membrane vibrating through one-third of the given amplitude. G. E. A.

2740. *Longitudinal Vibrations of a Liquid contained in a Tube with Elastic Walls.* **T. H. Gronwall.** (Phys. Rev. 30. pp. 71–83, July, 1927.)—This paper investigates the most general longitudinal vibrations of an elastic tube partly filled with liquid. From the rather complicated exact solution of the problem a simple approximate formula is derived for the reduction of the velocity of sound in the liquid due to the vibrations of the wall of the tube. AUTHOR.

2741. *Reflection of Sound from a Porous Surface.* **E. T. Paris.** (Roy. Soc., Proc. 115. pp. 407–419, July 1, 1927.)—Treats the problem by the introduction of a new quantity, the *acoustical admittance* per unit area of absorbing surface. This quantity can be readily measured by a stationary wave-form of apparatus, and when it is known the coefficient of absorption for sound of the particular wave-length can be calculated for any angle of incidence for the particular substance by means of simple formulæ. Interesting results are shown for the variation of the coefficient of absorption with the angle of incidence for a certain acoustic plaster. W. H. Ge.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS AND ATMOSPHERIC ELECTRICITY.

2742. *Theory of Sub-Electrons.* **T. Peczalski** (Comptes Rendus, 185. pp. 49–51, July 4, 1927.)—Starts from the equation of Langevin for the energy of the electromagnetic wave sent out by a charged particle, suspended in a gas, when a gas molecule collides with it, and deduces that the quantity of energy is inversely proportional to the square of the mass of the particle. Shows that as the mass diminishes the apparent charge diminishes, as observed by Ehrenhaft, if the real charge remains the same. Shows how the formulæ obtained are modified when the radiation takes place by quanta, and deduces that the Brownian motions must persist even for the smallest charged particles, which agrees with observation. The theory explains the condensation of water drops about charged molecules or particles, and the absorption of electromagnetic waves by a dry atmosphere, containing a large number of particles charged by the photoelectric effect. H. N. A.

2743. *Modification of Gordon's Equations.* **H. Bateman.** (Phys. Rev. 30. pp. 55–60, July, 1927.)—The expressions for the density of electricity and current given recently by W. Gordon [see Abstract 1417 (1927)] are modified so as to give the wave equations used by de Broglie and Schrödinger. The new equations are derived from a variational principle, which also gives some other equations of considerable interest. A stress energy tensor is derived from the Lagrangian function by Schrödinger's rule and is used to determine one of the constants in Schrödinger's equation. The analysis seems to indicate that a stationary isolated electron has a definite boundary and uniform volume density of electricity. AUTHOR.

DISCHARGE AND OSCILLATIONS.

2744. *Sparking Potential. Part II.* **F. Klingelfuss.** (Ann. d. Physik, 83. 4. pp. 565–574, June 28, 1927.)—Continues a previous paper [see Abstract 1493 (1927)]. The coefficients in the exponential portion of the equation for the sparking potential between two spherical electrodes are determined from the electrode function, under the assumption that, when a spontaneous discharge takes place, the number of carriers present in unit volume at times t is equal to the number of carriers produced in unit volume in the very short time $t - t_0$. The potentials calculated from the equation agree with the measurements of Peek for spheres of 25 cm. diameter, with spark lengths of 1 cm. to 40 cm., almost exactly. Differences between the calculated and experimental results with other diameters require investigation. H. N. A.

2745. *Lag in Electrical Discharges.* **W. Clarkson.** (Phil. Mag. 4. pp. 121–133, July, 1927.)—The variation of the "peak" voltage in the intermittent discharge in discharge tubes of scrupulous cleanliness are considered, and possible causes, both in the gas and in the electrodes, are sought for and applied in explanation. Experimental results would agree with a "corona" lag, a theory of which is developed, if a slow "build up" is assumed. This assumption is shown to be justified from results obtained by a method, here described, for measuring the time of duration of a "flash," or condenser discharge. The small perliminary discharges often preceding a "flash" are explained on the same assumption, due to the form of the "corona characteristic." Possible causes of this slow "build up" are discussed, and it is tentatively associated with the apparently inevitable modification of the kathode surface by the filling gas. AUTHOR.

2746. *Probability of Ionisation of Mercury Vapour by Electron Impact.* **T. J. Jones.** (Phys. Rev. 29. pp. 822–829, June, 1927.)—Electrons from a hot filament were projected into an ionisation chamber containing Hg vapour, and were prevented from scattering by a magnetic field parallel to the electron beam. The positive ions produced in a definite length of the path were collected on a plate electrode at the side of the path, and the primary electrons were finally collected by a Faraday cylinder. Consideration of the measurements indicates that the assumption that only singly charged ions are produced at an impact is invalid, a view that is supported by the experiments of Smyth. Assuming that at 400 volts doubly charged and singly charged ions are produced in equal amounts, which seems reasonable from Smyth's experiments, the author's results show that at this voltage the probability of ionisation at an impact is about 0·6 while the probabilities of the formation of double and of single ions are for each about 0·3. The values obtained by other observers for other gases may require modification in view of the above facts. H. N. A.

2747. *Ionisation by Collisions of the Second Kind in Mixtures of Hydrogen and Nitrogen with the Rare Gases.* **G. P. Harnwell.** (Phys. Rev. 29. pp. 830–842, June, 1927.)—The products of ionisation were studied by means of positive-ray analysis, He, Ne and Ar being mixed with H and with N. The observations were made at different pressures, and the variations of the types of ions found determined. The author concludes that during a certain proportion of the total number of collisions between an atomic or a molecular ion and an atom or ion of lower ionising potential an electron transfer takes place. The probability that a given transfer will occur appears to be an inverse function of the difference between the ionising potentials involved, and by far the most probable transfers seem to be those in which the ionising potentials of the two gases are nearly equal; the formation of $24N_2^+$, the nitrogen ions produced by 24 volts, by Ne^+ (ionising potential 24·5 volts), was, for example, found to be the most probable of all the processes occurring in nitrogen. H. N. A.

2748. *Dissociation of Hydrogen by Electrons.* **A. L. Hughes** and **A. M. Skellett.** (Phys. Rev. 30. pp. 11–25, July, 1927.)—Electrons were driven down the axis of a tube containing hydrogen. Atomic hydrogen formed by dissociation was condensed on the walls of the tube, which was immersed in liquid air. The rate of dissociation was calculated from the rate of change in pressure as measured by a special hot-wire gauge which was so designed that the galvanometer deflection was strictly proportional to the pressure from less than 10^{-5} mm. to 0·27 mm. The deflections were recorded photographically. With both 100-volt electrons and 20-volt electrons the rate of diminution of pressure is directly proportional to the pressure. Hence the dissociation of hydrogen by electron impact cannot be a secondary effect, the result of a collision between a neutral hydrogen molecule and an ionised or excited molecule, unless the mean free path of the ionised or excited molecule is less than 1/300 that of the normal molecule. This latter is a most unlikely possibility. The dissociation is therefore very probably produced as a direct result of the impact of an electron on the molecule, a result which is strongly supported by the studies of the intensities of hydrogen lines at different pressures by Blackett and Frank, and by Lowe. It was found that dissociation began when the electrons had an energy corresponding to 11·5 volts.

AUTHORS.

2749. *Positive-Ray Analysis of Nitric Oxide and Collisions of the Second Kind.* **T. R. Hogness** and **E. G. Lunn.** (Phys. Rev. 30. pp. 26–30, July, 1927.)—Using an apparatus previously described, in which ions formed by impact of electrons of definite energy are analysed by Dempster's positive-ray method, the relative numbers of the ions NO^+, N^+ and O^+ were measured over a large range of pressures and electron energies. The percentages of N^+ and O^+ increased gradually with increase in pressure from approximately 4 and 1·5 % at zero (extrapolated) pressure to 9 and 3 % respectively at 0·01 mm. Evidence is thus given that impact electrons of sufficient energy can ionise the molecules forming NO^+ ions, some of which spontaneously dissociate, forming N^+ and O^+, and others of which are disrupted on collision with gas molecules into the atomic ions. The ionisation potentials for the formation of NO^+, N^+ and O^+ were found to be 9, 21 and 22 volts respectively. The second, together with the ionisation potential of the oxygen atom, gives 7·5 volts (175,000 cal. per mol.) for the heat of dissociation of nitric oxide. In mixtures of NO and A and of NO and He, an increase in the relative intensities of NO^+ with increase in pressure gave definite evidence of collisions of the second kind: $NO + A^+ = NO^+ + A$ and $NO + He^+ = NO^+ + He$. [See also Abstract 2175 (1926).]

AUTHORS.

2750. *Electric Glow Emission of Metals with Alteration of Condition of Kathode Materials. The Electric Glow Fusion Diagrams of Silver, Gold and Copper.* **A. Goetz.** (Zeits. f. Physik, 43. 8. pp. 531–562, 1927.)—The present paper is a continuation of the recently published work on the electric glow measurement of emission with differing conditions. Experiments are carried out on silver, gold and copper, on the emission processes with fusion and crystallisation, on the course of work of emission of solid and fluid metals, on the magnitude and importance of the constants A and A_0, and on the question whether there is a discontinuity of emission at the melting point. The possibility of a physical explanation of the results is discussed, and a comparison is made with earlier results, the possible sources of error being investigated. A series of phenomena are also described which are observed with fusion and crystallisation processes in high vacua. [See also Abstract 2361 (1927).]

A. E. G.

2751. *Electron Emission under the Influence of Chemical Action at Higher Gas Pressures, and Some Photoelectric Experiments with Liquid Alloys.* **O. W. Richardson** and **M. Brotherton.** (Roy. Soc., Proc. 115. pp. 20–41, June 1, 1927.)—A continuation of work described in four previous papers by one or the other of the two authors [see Abstract 1870 (1924)]. Drops of NaK alloy of different compositions fell into a testing chamber containing $COCl_2$ at a low pressure, and the saturation current was measured. It was found previously that the electrons were emitted from the drops with a Maxwell distribution of energy for a temperature of about 3300° K., but a value about 2300° K. is now obtained. The difference between the apparent contact potential as determined from the properties of the chemically emitted electrons and by photometric methods has been investigated in an attempt to find the reason for the above discrepancy. It can be accounted for by assuming that the chemical reaction does not take place uniformly over the surface of the drop, but in localised patches. This theory of patches also accounts for the difficulty of attaining saturation and the non-agreement with the Maxwell formula near zero emission velocity. H. N. A.

2752. *Electron Emission from Thoriated Tungsten.* **S. Dushman** and **Jessie W. Ewald.** (Phys. Rev. 29. pp. 857–870, June, 1927.)—Constants of the electron emission from a monatomic layer of thorium on tungsten at temperatures from 1000° to 2000° K.—The electron emission for a monatomic layer of thorium on tungsten is best represented for zero field strength by the relation $I = 3T^2\epsilon^{-30,500/T}$, where I is expressed in amperes/cm.^{2}. The emission was measured for different states of activation of the filament. If θ denote the fraction of the surface covered with thorium, then for $\theta < 0 \cdot 95$ (approximately) $\log A_\theta$ varies linearly with b_θ, where the emission for the given surface is represented by $I = A_\theta T^2\epsilon^{-b_\theta/T}$. It is also pointed out that the emission for a monatomic film of thorium on tungsten is greater than that observed for metallic thorium. AUTHORS.

2753. *Theory of the Current due to Electrical Scattering.* **W. Kastrow.** (Phys. Zeits. 28. pp. 440–444, June 15, 1927.)—Considers the current process in a gas during the time, which is generally very short, during which the ions arrange themselves under the action of the electrical field, before the value of the current becomes stationary. In the case considered the gas is assumed to be uniformly ionised, and a charged body is introduced into it. The charge is "scattered" in the gas surrounding the body, the ions travelling in opposite directions. Curves are obtained showing the relation between the fraction of the original charge remaining in the conductor at different times, the mobilities, concentrations and diffusion coefficients of the positive and negative ions being considered. H. N. A.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

2754. *Departure of Electrolytes from Ohm's Law.* **M. Wien.** (Ann. d. Physik, 83. 3. pp. 327–361, June 16, 1927.)—Conductivity measurements are made at high frequencies and at voltages up to 80 kV/cm. by a resonance method, and also by a bridge method, of solutions of sodium chloride, sulphuric acid, beryllium sulphate and calcium and barium ferrocyanide. The dimensions of the conductivity cells are varied so as to give similar resistances and decrements. In all cases the conductivity increases with increasing voltage by a larger amount than that due to the thermal effect and represents a departure from Ohm's law. In some cases the increase of conductivity amounts to 60 %. Increasing the periodicity beyond about 10^6 cycles per second causes a slight diminution of the effect. With polyvalent ions the effect increases largely with increasing decrement of the oscillating circuit, and thus distinguishes this departure from the influence of the thermal effect. With a uni-univalent salt the influence of decrement is very small. The increase of conductivity with voltage diminishes with increasing voltage, and with dilute solutions a limiting asymptotic value for the equivalent conductivity is approached which is the same as the value of λ_∞. The limiting value of the voltage increases with increasing concentration and increasing valency of the ions and cannot be approached with concentrated solutions. For dilute solutions, the increase of conductivity with voltage is given approximately by the equation :—

$$\Delta\lambda_\zeta = \lambda_0(1 + 4\cdot 0\nu_1^2\nu_2^2 10^{-5}\zeta),$$

where ζ is the field in kV/cm. and ν_1, ν_2 are the valencies of the ions. [See also Abstracts 1280 (1924) and 657 (1925).] J. N. P.

2755. *Hall Effect in a Bismuth Crystal.* **C. W. Heaps.** (Phys. Rev. 30. pp. 61–65, July, 1927.)—The Hall effect has been measured in plates cut in different directions from a single large crystal of bismuth. At room-temperatures, when the field H is perpendicular to the trigonal axis, a negative Hall coefficient R is obtained, decreasing from about 15 for H = 1000 gauss to about 7 for H = 8000. For H parallel to the trigonal axis a positive coefficient of about unity is obtained, increasing slightly with the field. R is positive for all orientations of the axis and decreases as H increases at − 186° C. The maximum R observed at − 186° C. was + 15 at H = 600. A plate made of compressed bismuth powder gave R = + 7 approximately at − 186° C. Beckman found large negative values of R for similar plates at this temperature. The Hall e.m.f. cannot be resolved into positive and negative components at − 186° C. in the way suggested by Becquerel. AUTHOR.

2756. *The Volta Effect.* **E. Dubois.** (Comptes Rendus, 184. pp. 1424–1425, June 13, 1927.)—A series of tests has been carried out on thermocouples of the effect on the potential difference of heating one element *in vacuo* as near as possible to the melting point, but in any case not above 1200° C. In all cases tested, the metal, after heating and subsequent cooling, became electro-negative. The metals tested were Zn, Al, Ag, Au, Cu, Ni, Fe and Pt, tested in each case against Cu as a standard. If, as is thought, the change is due to the removal of an impurity, this impurity must be common to all. The necessary conditions required are for the heating to be sufficiently prolonged and to a high enough temperature. Further tests are to be made on the nature of this impurity. R. S. R.

2757. *Dielectric Constants and Magnetic Susceptibilities in the New Quantum Mechanics.* **J. H. van Vleck.** *Part I.* (Phys. Rev. 29. pp. 727–744, May, 1927). *Part II.* (*ibid.*, 30. pp. 31–54, July, 1927.)—Part I investigates the general proof of the Langevin-Debye formula, $\chi = N(\alpha + \mu^2/3kT)$, where χ is the susceptibility, N the number of atoms or mols. per unit vol., k the gas constant, α a constant independent of the absolute temperature T, and μ the permanent electric or magnetic moment of the molecule, depending on whether electric or magnetic polarisation is being considered. The proof given is claimed to be more comprehensive than previous ones, since it assumes only that the atom or molecule has a permanent vector of constant magnitude μ whose precession frequencies are small compared to kT/h. The presence of other simultaneous external fields in addition to the applied electric or magnetic field introduces no difficulty. The term $N\alpha$ arises from high-frequency matrix elements associated with transitions from normal to excited states, and is proved to be independent of temperature. The susceptibility formula contains the factor 1/3 in the temperature term as generally as in the classical theory because of the high spectroscopic stability characteristic of the new quantum mechanics. It is also shown that the mean squares of the x, y and z components of a vector are equal in the new quantum dynamic, as in the classical theory, the only difference being that in the former the average is taken by summation over a discrete distribution of quantum-allowed orientations instead of by integration. [See also Abstract 216 (1927).]

Part II gives the application to dielectric constants. It is shown that the Debye formula applies to asymmetrical models with three unequal moments of inertia quite as well as to asymmetrical molecules. Unlike the old quantum theory, there is no abrupt change of dielectric constant with pressure or field strength due to the passage from weak to strong spacial quantisation. The influence of a magnetic field is discussed, following which a general formula is derived for the refractive index, which shows that the refractivity per mol. should not vary with temperature despite temperature rotation of the nuclei about the centre of gravity. The experimental verification of the latter verifies the sum-rules characteristic of the new quantum mechanics. The effect of infra-red vibration bands is then considered. It is shown that the Debye formula holds only asymptotically at high temperatures, whereas in ordinary cases only a very small correction is necessary. The paper concludes with a discussion of the general classical derivation of the Langevin-Debye formula; the latter reduces to the ordinary Debye expression if the dynamical system consists of a rotating elastic polar molecule executing small vibrations about an equilibrium configuration. H. H. Ho.

2758. *The Dielectric Constant of Atomic Hydrogen in Undulatory Mechanics.* **P. S. Epstein.** (Nat. Acad. Sci., Proc. 13. pp. 432–438, June, 1927.)—Van Vleck [see Abstract 1157 (1927)], using the expressions for the energy of a hydrogen atom in an electric field derived by Waller [see Abstract 365 (1927)] and the author [see Abstract 1793 (1926)] for computing the dielectric constant has shown that, from the point of view of undulatory mechanics, an atom in the normal state must change its energy in weak and in strong fields according to the same law. The present paper deals with the problem by a different method connected with the question of orientation with respect to the field, and brings out the similiarities and the differences between the old and the new theory. It is found for the excited states of the atom that the conditions are much the same in undulatory mechanics as those found by Aylesworth [see next Abstract on the Bohr theory], *viz.*, in weak fields the orientation is arbitrary, in strong ones it has a relation to the field. On the other hand, the question of orientation is without meaning for the normal state of the atom, owing to its complete spherical symmetry. For this state, the system can be quantised in any system of polar or parabolic coordinates leading always to the same type of pulsation and to the same energy expression. H. H. Ho.

2759. *The Dielectric Constant of Atomic Hydrogen from the Point of View of Bohr's Quantum Theory.* **E. F. Aylesworth.** (Nat. Acad. Sci., Proc. 13. pp. 438–445, June, 1927.)—This paper investigates the question as to whether a hydrogen atom in an electric field acquires a definite orientation or not from the standpoint of Bohr's theory. Since Jones' formula [see Abstract 2588 (1924)] for the dielectric constant of atomic hydrogen is in contradiction to one based on the Bohr theory, the author finds the discrepancy to be due to omission on Jones' part of considering the relativity terms in the motion of the electron. It is shown that the orbits of the hydrogen atom will acquire an orientation with respect to an external electric field only if the field strength is above a critical value, and that there will be no orientation for fields considerably lower than this value. H. H. Ho.

2760. *Dielectric Constants of the Vapours of Ethyl Ether and Ethyl Alcohol.* **R. Sänger.** (Phys. Zeits. 28. pp. 455–457, June 15, 1927.)—A continuation of a previous investigation, in which CH_4, CH_3Cl, CH_2Cl_2, $CHCl_3$, and CCl_4 were dealt with [see Abstract 782 (1927)]. The density was kept constant and the dielectric constants were measured at different temperatures and plotted against the reciprocals of the temperatures. For ether the relation was linear from 315·6° to 433°, increasing as the temperature was lowered; for alcohol it was linear for high temperatures, but increased more rapidly as the boiling (or liquefying) point was approached. Debye's formula for the relation of the dielectric constant and the temperature is simplified for gases to $\epsilon - 1 = 4\pi N(\gamma + \mu^2/3kT)$ or $\epsilon - 1 = A + B/T$. For ether vapour $B = 0{\cdot}710_8$, and from this $\mu = 0{\cdot}9_9 \,.\, 10^{-18}$, while for hot alcohol vapour $B = 0{\cdot}721_8$ and $\mu = 1{\cdot}1_1 \,.\, 10^{-18}$. The differences between A and $(n^2 - 1)_{\lambda = \infty}$ are large, which indicates that for large molecules, like those of alcohol and ether, the infra-red absorption cannot be neglected. Other theoretical points are considered. H. N. A.

2761. *Dielectric Constants of Binary Mixtures. Part II. The Electric Moments of Certain Organic Molecules in Benzene Solution.* **J. W. Williams** and **I. J. Krchma.** (Am. Chem. Soc., J. 49. pp. 1676–1686, July, 1927.)—By an experimental method previously described [see Abstract 2946 (1926)] the dielectric constants of a series of binary mixtures formed by benzene with *p*-xylene, *o*-xylene, ethyl ether, chloroform, chlorbenzene, and phenol are determined at 25° C. The results are tabulated, together with the data for density and refractive index. The systems are grouped for discussion according to whether or not the molar polarisation of the solute in solution changes with concentration. The electric moments of each of the solute molecules in benzene solution are calculated and the results critically discussed. The advantages of the application of the Clausius-Mosotti law to the treatment of the dielectric constant data of binary liquid mixtures are pointed out. A. B. C. L.

2762. *Dielectric Properties of Para-Azoxyanisols.* **W. Kast.** (Ann. d. Physik, 83. 3. pp. 391–417, June 16, 1927. Zeits. f. Physik, 42. 1.

pp. 81–85, 1927.)—A study of the orientation of the particles of fusions of *p*-azoxyanisols contained between the plates of a condenser in a magnetic field. W. H. Ge.

2763. *Investigation of Certain Aqueous Electrolyte Solutions by Fürth's Ellipsoid Method.* **R. Pechhold.** (Ann. d. Physik, 83. 3. pp. 427–456, June 16, 1927.)—Fürth's method for measuring the dielectric constant of conducting liquids [Abstracts 1571 (1924), 1161 (1925)] is shown to be capable of improvement so as to be applicable to solutions of conductivity $4\cdot10^{-3}\,\Omega^{-1}$ cm.$^{-1}$ with a mean error of 2 to 3 %. Using a frequency of 50 per sec., measurements have been made by this method of the dielectric constant of aqueous solutions of various concentrations of potassium, sodium, lithium, and hydrogen chlorides and of sodium hydroxide. As the concentration increases, the dielectric constant diminishes to a minimum, then increases to a value exceeding that for water, and then appears to change gradually. With the chlorides, the steepness of the falling branch of the curve increases in the order K, Na, Li, H, the minimum at the same time becoming less and occurring at lower concentrations. Sack's results [see Abstract 2139 (1927)] are discussed. T. H. P.

2764. *Electrical Deformations of Quartz.* **N. T. Ze.** (Comptes Rendus, 184. pp. 1645–1647, June 27, 1927.)—Quantitative determinations are made of the deformations under electrical stress of rectangular plates of quartz, the method employed being analogous to that of Fizeau, the effects of light interference being also brought into service. In directions normal to the optical and electrical axes, positive charges produce dilatation. For relatively low potentials—up to 40 kV—deformation is proportional to potential, with a constant $6{\cdot}4 \times 10^{-8}$, but for higher potentials the deformation tends towards a limit at about 160 kV. Formulæ are given expressing the results obtained in other principal directions. It is pointed out that a plate of quartz once standardised can be used for the measurement of high potential differences. The deformations are produced instantaneously and regularly, and are devoid of hysteresis. A. B. C. L.

2765. *A Null Method of Measuring Resistance to Transient Currents.* **J. Malsch** and **M. Wien.** (Ann. d. Physik, 83. 3. pp. 305–326, June 16, 1927.)—A null method of measuring resistance to transient currents at high potential is described, in which an accuracy of at least one part in a thousand may be attained. The method may also be applied to liquid resistances. G. E. B.

2766. *Determination of the Capacity of Electrometers.* **H. Witte.** (Phys. Zeits. 28. pp. 429–440, June 15, 1927.)—The method of Pungs and Preuner, in which the beats produced in an oscillating, high-frequency circuit when the capacity to be measured and the adjustable standard capacity placed in parallel with it are not exactly equal, was employed to measure small alterations of the capacity. A single filament electrometer was investigated, and the relation between its capacity and the position of the adjusting knife-edges determined. The alterations in the capacities of different patterns of electrometer caused by their deflections was measured. In determining the absolute values of the capacities of electrometers it was found necessary to adopt a method in which comparison experiments with dummy electrometers were made. H. N. A.

2767. *An Electrometer for Determining the Amount of Emanation in Ground Air.* **R. Ambronn.** (Phys. Zeits. 28. pp. 444–446, June 15, 1927.)—Describes a very portable single-thread electrometer, mounted, above an air chamber containing a piston, on a tripod stand for use in the field. The chief improvement on the form previously employed by the author is that the air is sucked from the ground and delivered under pressure to the cylinder of the instrument by a separate pump, thus avoiding the leaking in of atmospheric air during the filling process. A small electric lamp warms the instrument, and keeping the surfaces dry preserves the insulation even in wet weather, provided the rain is not allowed to fall on them. H. N. A.

ALTERNATING CURRENTS AND MAGNETISM.

2768. *Certain Peculiarities of Ferro-Resonance when the Resistance is not Negligible.* **Rouelle.** (Comptes Rendus, 184. pp. 1426–1428, June 13, 1927.)—The author has studied in detail a circuit consisting of an induction coil with an iron core, joined in series with an ohmic resistance, a condenser and an alternating-current supply. The current flowing was varied by altering in turn any one of the factors—the supply voltage, capacity, inductance and ohmic resistance. Two critical values of the current are found. With a feeble current increasing to one critical value there is a discontinuous and irreversible increase, and with a strong current decreasing towards the second critical value there is a discontinuous and irreversible decrease. Further, it was possible to perform a closed irreversible cycle of operations around these points. This holds whichever of the factors is varied, except for certain special values of the resistance. The potential differences across the condenser and coil when the circuit resistance is negligible or small, and the phase of the current are also examined. R. S. R.

2769. *Ferromagnetic Hysteresis Heating and Magnetic Energy.* **U. Adelsberger.** (Ann. d. Physik, 83. 2. pp. 184–212, June 8, 1927.)—An experimental and theoretical treatment of the subject. W. H. Ge.

2770. *Magnetic Field with Spiral Lines of Force.* **J. Spielrein.** (Archiv f. Elektrot. 18. pp. 366–368, June 10, 1927.)—An analytical discussion of a field in which the lines of force take the form of spirals, the axes of the spirals being circles. A magnetic field of this type may be realised by using a long straight wire on which is threaded a circular conductor whose plane is normal to the wire and whose centre is on the axis of the wire, both wire and circle carrying steady currents. A. H.

2771. *Results of Earth-Resistivity Surveys near Watheroo, Western Australia, and at Ebro, Spain.* **W. J. Rooney** and **O. H. Gish.** (Terrest. Magn. 32. pp. 49–64, June, 1927.) See also Abstract 1535 (1926).

2772. *The Earth's Magnetic Field and Internal Electromagnetic Properties.* **M. Brillouin.** (Comptes Rendus, 184. pp. 1381–1385, June 13, 1927.)—Expressions are found for the intensity of magnetisation at any point in the interior; also, supposing that the field at the surface is due to internal currents, the component densities of these currents are also expressed. This is considered an indispensable step before any hypothesis is formed as to the magnetic constitution and conducting properties of the earth. G. E. A.

2773. *Electromotive Forces possibly produced by the Earth's Rotating Magnetic Field and Diurnal Variation of the Atmospheric Potential Gradient.* **G. R. Wait** and **H. U. Sverdrup.** (Terrest, Magn. 32. pp. 73–83, June, 1927.)—Making certain assumptions, the e.m.f. induced at the earth's magnetic pole due to the rotation of its magnetic field is calculated. This can generate a current by its action on charged particles reaching the upper atmosphere from the sun. From the tabulated values and curves drawn, the current shows diurnal and annual variations of phase angle and amplitude which are in remarkable agreement with the atmospheric potential gradient observed at sea by the *Carnegie*, by the *Maud* expedition in the Arctic, and at certain land stations. Several possible physical considerations are examined which might give a physical basis to explain the agreement, which the authors consider is not accidental. R. S. R.

2774. *Oscillation of the Earth's Axis a Consequence of the Sun's Activity.* **R. Kolisko.** (Ann. d. Physik, 83. 2. pp. 284–286, June 8, 1927.)—Regarding the earth as a magnet vibrating with an eleven-year period in a magnetic field, a field intensity of $6\cdot 5 \times 10^{-8}$ is found, or almost the same magnitude as Newton's gravitation constant. An estimate is also made of the average earth current. G. E. A.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

2775. *The Structure and Stability of the Carbon Arc in Relation to its Ultra-Violet Output.* **H. D. Griffith, J. S. Taylor** and **J. M. Jack.** (Brit. J. of Radiology, 23. pp. 203–214; Disc., 214–216, July, 1927.)—Measurements were carried out by means of a spectroheliographic method, fully described, upon open arcs with carbon electrodes. It is claimed that ultra-violet radiation is produced more abundantly in the flame than at the positive pole in the proportion of two to one, and this is confirmed by experiments upon cultures of *B. coli.* The relation of output to watts and arc length was studied as well as the variation of output with arc length. The conditions of stability of the arc are considered. The authors reach the conclusion that, for the same energy input, a single arc working at maximum length, compatible with stability, is a more efficient source of ultra-radiation than multiple arcs in series. In the *Discussion,* **W. E. Schall** pointed out that in the experiments the spectroheliograph was not directed towards the crater but across the crater. A member also suggested that the crater was the most abundant source of radiation. B. J. L.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

2776. *Thickness of Adsorbed Vapour Films.* **J. C. W. Frazer, W. A. Patrick** and **H. E. Smith.** (J. Phys. Chem. 31. pp. 897–905, June, 1927.)—The thickness of adsorbed vapour films was studied by the method developed by McHaffie and Lenher. The method consisted in measuring the vapour pressure in a vessel of known volume and surface area over a temperature range sufficient to insure the existence at the lower temperature of a liquid and at a higher temperature of all the vapour in the gaseous condition. The results showed that the thickness of the adsorbed film of toluene on a plane surface was never greater than unimolecular, even at saturation pressures. Glass washed with acids and water did not present a plane surface. Water vapour reacted with fresh glass surfaces so as to render the latter no longer plane. The results were discussed in relationship to their bearing on existing theories of adsorption. F. J. B.

2777. *Effect of Electrification on Adsorption.* **O. Blüh** and **N. Stark.** (Zeits. f. Physik, 43. 8. pp. 575–590, 1927.)—The general view is that the forces of adsorption are electrical and can be graphically treated. Starting from this point of view, the influence of an external electrical field on the strength of adsorption was investigated mathematically. The results indicate that such an effect can be observed. If no other assumption is made than the dipolar structure of the adsorbed molecules, the results lead to the conclusion that the effect of the electrical field is independent and apolar. The fields at the surfaces of the ion lattices was also considered. At molecular distances these fields are considerable, so that the formation of several molecular layers from the first layer, by polarisation of the first layer by the fields of the ion lattice, is probable. F. J. B.

2778. *Expansion of Charcoal on Sorption of Carbon Dioxide.* **F. T. Meehan.** (Roy. Soc., Proc. 115. pp. 199–207, June 1, 1927.)—In this paper measurements at various temperatures are recorded of the expansion of yellow-pine charcoal due to sorption of carbon dioxide up to a pressure of 1 atmosphere, a process which has been found reversible. The æolotropic structure of wood is destroyed on carbonisation, the resulting charcoal being isotropic. At constant temperature the relation of expansion to pressure has been found better represented by the equation $\log E/p = G + HE$ than by the usual expression $E = kp^{1/n}$, where G, H and k are constants. At constant pressure expansion is related to temperature by the expression $1/E = AT + B$, and the relations of expansion to temperature and pressure hold both above and below the critical temperature of carbon dioxide. Experimental details are included. H. H. Ho.

2779. *Experimental Test of the Dipole Theory of Adsorption.* **W. G. Palmer.** (Roy. Soc., Proc. 115. pp. 227–236, June 1, 1927.)—The method formerly described [see Abstract 1137 (1926)] is adapted without essential modification to the study of adsorption from liquids in which the cohering junction is completely immersed. Owing to the appreciable conductivity of liquids other than hydrocarbons, the condenser formerly used as a means of applying electric tension to the junction has in the present work been replaced by direct connection to the potentiometer through a resistance of 10,000 ohms. Both methods give identical results. It is found that the cohering voltage increases regularly in the homologous series of primary alcohols, fatty acids, and their ethyl esters according to the rule $\frac{E^2}{l} = \text{constant}$, where l is the length of the atomic chain. This experimental result is shown to indicate that the energy of desorption in a given series is proportional to the square of the electric moment of the adsorbed molecule, and thus strongly supports the dipole theory of adsorption. This theory may be extended so as to include the adsorption of substances such as hydrocarbons, which are normally only feebly polar. T. H. P.

2780. *Critical Solution Temperatures of Mixtures of Alcohols and Hydrocarbons.* **A. Boutaric** and **G. Corbet.** (Comptes Rendus, 184. pp. 1446–1447, June 13, 1927.)—Difficulties in the determination of critical solution temperatures arising from equal or nearly equal indices of refraction of the imperfectly miscible liquids or from low critical solution temperatures are overcome by the addition of a series of definite small quantities of a suitably chosen third substance to one of the components. Colza oil is thus used as an addition to benzene in the determination of the critical solution temperatures of its mixtures with methyl and ethyl alcohols. With alcohol and petrol, water is added to the alcohol. The general characteristics of the curves obtained by such means are briefly discussed, and it is noted that, contrary to general opinion, petrol and alcohol are not miscible in all proportions at all temperatures. A. B. C. L.

2781. *Chemical Valency.* **C. D. Niven.** (Phil. Mag. 3. pp. 1314–1334, June, 1927.)—The paper opens with the table of extra-nuclear electronic configurations of the elements taken from one of McLennan's papers (Heisenberg-Hund model), and discusses diatomic molecules, the oxides of nitrogen, hydrides, organic compounds, alternative valencies (with respect to nitrogen, oxygen, sulphur, copper, palladium, iron chromium), and briefly Werner's coordination theory. In accordance with the model, diatomic elementary gases should have an asymmetrical structure; nitrogen should be inert; CO_2 and N_2O should have the same electronic arrangement, as they have similar crystal structures and magnetic properties. Acidity is ascribed to exposed protons. The difference between inorganic and organic compounds is attributed to the inability of carbon atoms to form a magnetic bond instead of an electrostatic bond. The stability of cyclic and heterocyclic rings in aromatic compounds and the similarity of the cyanogen radicle to a halogen atom are explained, and the structure of diamond is accounted for without reference to a two-electron bond. H. B.

2782. *Alloys of Iron and Manganese containing Low Carbon.* **R. Hadfield.** (Iron and Steel Inst., J. 115. pp. 297–361; Disc. and Corres., 362–363, 1927.)—A detailed historical survey of the subject is given, with particular reference to the invention and development of the manganese steels. The present research embraces the study of alloys containing from 0·06 % to 38·9 % Mn, carbon not exceeding on the average 0·08 %. The alloys are examined in both the cast and the forged condition, (1) untreated; (2) after annealing by heating to 860° to 890° C. and cooling slowly; (3) water-quenched from a high temperature, the latter treatment being applied to determine whether toughening occurs as in standard Hadfield manganese steel. The tests include (*a*) for the cast material: bending tests on cast strips and transverse bars; Brinell ball-hardness and hammer-hardening tests; (*b*) for the forged material: bending tests on forged strips; tensile tests: Frémont shock tests on nicked and on plain specimens; hammer-hardening tests; Brinell ball-hardness tests. In the case of the forged material, a series of tests of the specific magnetism and electrical resistance is carried out, and the heating and cooling curves, corrodibility and microstructure of the alloys in the series are determined. The properties of the particular alloy Mn 83·5 %, C 0·29 % are also investigated. None of the series shows valuable or useful qualities for industrial applications, but the results obtained serve to explain the special qualities of manganese steel. In discussing the respective effects of carbon and manganese on the magnetic properties of manganese steels, it is observed that while in the Fe-Mn alloys practically free from C at least 16 % Mn is necessary to obtain non-magnetic qualities, the addition of 1 % C enables this effect to be obtained with only 7 % Mn. The remarkable influence of C in its effect on the mechanical and other properties of maganese steels is also strongly emphasised. A. B. C. L.

2783. *Thermal Changes in Low-Carbon Iron-Manganese Alloys.* **R. Hadfield.** (Roy. Soc., Proc. 115. pp. 120–132, June 1, 1927.)—The researches described in the present paper form an extension of a series previously described [see preceding Abstract]. Observations are made of the thermal and magnetic effects obtained during heating and cooling of a range of Fe-Mn alloys, of negligible carbon content, extending to about 80 % Mn. Magnetic transformations are confined to the range of alloys containing up to 16 %, suggesting the possible formation of the compound Fe_5Mn. In certain of the magnetic alloys a curious doubling of the magnetic transformation on cooling, but not on heating, is noted, the first recovery of magnetism appearing only over a limited range of temperature, disappearing, and again reappearing on approaching atmospheric temperatures. For all alloys up to 14·3 % Mn a reversible magnetic transformation occurs at practically the same temperature as the A_2 magnetic change in iron. In alloys up to 3·95 % Mn one critical change is noticeable, magnetism reaching its full and constant value after a slight fall of temperature below the critical point. Magnetic changes decrease in amount with increasing Mn content. A second critical magnetic change point occurs in alloys of Mn content from 6·75 %, where it occurs at 315° C., decreasing progressively to about 100° C., with corresponding weakening, with increasing Mn content to 12·95 %. A thermal evolution corresponding with the last-mentioned magnetic effect is noted, although in some respects the relations between thermal and magnetic effects are apparently anomalous. A. B. C. L.

2784. *Attempts to Separate the Isotopes of Mercury by Chemical Means.* **H. S. King.** (Am. Chem. Soc., J. 49. pp. 1500–1511, June, 1927.)—It is argued that " oxidation-reduction " reactions of the type $M_2X_2 = M + MX_2$ should effect a partial separation of isotopes. The conflicting results obtained from the use of reactions of this type between Grignard reagents and metallic salts in order to achieve a partial separation of isotopes are referred to [see Abstract 2006 (1926)]. Atomic weights of extreme fractions of Pb so obtained differ only within the limits of experimental accuracy. An experimental study is made of six reactions of this type, all involving Hg compounds, the samples of Hg obtained being purified by elaborate chemical and physical means. No difference in density between extreme fractions is found greater than 19 parts in 10,000,000, although this negative result is regarded rather as indicating that the necessary irreversible conditions did not obtain than that mass has no influence in determining which of two isotopic Hg atoms is ejected from the molecule. A. B. C. L.

2785. *Gaseous Combustion at High Pressures. Part VII. Spectrographic Iuvestigation of the Ultra-Violet Radiation from Carbonic Oxide-Oxygen (or -Air) Explosions.* **W. A. Bone** and **D. M. Newitt.** (Roy. Soc., Proc. 115. pp. 41–58, June 1, 1927.)—Describes a spectrographic investigation of the ultra-violet radiations from $2CO - O_2 + 4R$ explosions, where R is a diatomic diluent; they are much less when R is CO or N_2 than with O_2, showing that the former gases strongly absorb the ultra-violet radiation from burning CO. The absorption is stronger at low than at high frequencies over the ultra-violet range 4400 to 3200 Å.U. The NO formation in a CO explosion with excess air takes place after all the radiation capable of affecting the photographic plate has been emitted. When NO is present during the explosion an absorption band spectrum is superposed on the continuous ultra-violet spectrum of CO. With $2CO + O_2 + 4Ar$, initial pressure 14 atmospheres, the spectrum is much stronger than with He, though the temperatures differ by only 130° C. The activation of nitrogen by the radiation emitted by burning CO at high pressures is of a lesser degree than that involving the formation of Rayleigh's active nitrogen. H. N. A.

2786. *Mechanism of Titration with Adsorbed Indicators.* **J. Hodakow.** (Zeits. phys. Chem. 127. pp. 43–50, June, 1927. Paper read before the Fifth Congress of Russian Physicists.)—The adsorbed quantity of dyestuff (methyl violet, which changes from blue to pink on adsorption) is considered as a function of the charge of a silver chloride sol, and a theoretical interpretation given of Fajans and Hassel's method of titration [Abstract 1039 (1924)] from the standpoint of the doctrine of adsorption. It is shown that a fundamental difference exists in the course of adsorption isotherms according as the sol has a charge of the same or the opposite sign as that of the colouring matter. In the former case $\left(\frac{dQ}{dc}\right)_{c=0} = \infty$ and in the latter this function $= 0$. Fajans and Hassel's view of the significance of the end-point of their titrations is criticised. T. H. P.

2787. *Homogeneous Reactions involving Complex Molecules. Kinetics of the Decomposition of Gaseous Dimethyl Ether.* **C. N. Hinshelwood** and **P. J. Askey.** (Roy. Soc., Proc. 115. pp. 215–226, June 1, 1927.)—The thermal decomposition of dimethyl ether takes place according to the equation $CH_3 . O . CH_3 \rightarrow [CH_4 + H . CHO] \rightarrow CH_4 + CO + H_2$, the formation of formaldehyde being only transitory. The reaction is empirically unimolecular at pressures above 300–400 mm., but at lower pressures it ceases to be independent of the initial pressure. In the presence of sufficient hydrogen the reaction maintains its unimolecular character at all pressures. The hydrogen seems to act only by preserving the Maxwell distribution among the molecules of the dimethyl ether when this would otherwise be disturbed by the chemical transformation of activated molecules, as it cannot do more than restore the rate of reaction to its normal limiting value, beyond which it cannot increase this rate. Nitrogen, helium, carbon dioxide, and carbon monoxide do not seem to have a similar influence. The limiting rate of reaction is expressed by the equation, $ln\, k = 30\cdot36 - \frac{58,500}{R\,.\,T}$. To account for the observed rate of reaction, the energy of activation must be supposed to be distributed between about eleven energy terms. [See also Abstract 1936 (1927).]

T. H. P.

2788. *End-Point Determination by Potentiometric Titration.* **F. L. Hahn** and **M. Frommer.** (Zeits. phys. Chem. 127. pp. 1–42, June, 1927.)—In potentiometric titrations it is most important that the addition of the reagents, both before and after the immediate end-point, should take place in quantities of equal size, in order to enable the correct interpretation of the curves to be arrived at. Comparatively large additions of reagents, followed by very small additions in the immediate neighbourhood of the end-point, will not give such accurate results as the addition of a series of exactly equal quantities. In the reaction between chloride and silver nitrate, by the addition of drops of 0·1 c.c. of a N/10 solution, results can be obtained by means of the method of interpretation of the curves developed by the authors, as accurate as by titration drop by drop with a N/40 solution. The titration of ferrous salts with permanganate is complicated by the occurrence of secondary reactions, but by the addition of drops of 0·05 c.c. of a N/10 solution results can be obtained as accurate as titration with one-seventh this quantity. The method of interpretation developed by the authors throws valuable light on the reason for the difference between the calculated and observed potential drops.

B. W. C.

2789. *An Improved Hydrogen Electrode Vessel and the E.M.F. of the Mercury, Mercurous Bromide, Bromide Ion Electrode.* **R. H. Gerke** and **J. R. Geddes.** (J. Phys. Chem. 31. pp. 886–889, June, 1927.)—Potential measurements are made of the combination

$$H_2/HBr\ 0\cdot1\ N/Hg_2Br_2(sat.)/Hg$$

in a specially designed cell of pyrex glass in which diffusion of the mercurous ions to the hydrogen electrode is prevented by interposing a layer of sand. The value found is 0·2685 volt. By taking the activity coefficient of the HBr as 0·814, the e.m.f. of a cell with 1 atm. of H_2 and HBr of activity 1 is computed to be 0·1396 volt and the potential of the electrode $Hg/Hg_2Br_2(sat.)/Br'$ to be − 0·1396 volt.

J. N. P.

2790. *Electrolytic Conductivity with High-Potential Fields.* **H. Schiller.** (Ann. d. Physik, 83. 1. pp. 137–152, May 23, 1927.)—An increase in the conductivity of electrolytes which has been observed with increasing potential field implies a change in the mechanism of ionic conductivity at high potentials. Measurements with direct current are made on glass by mounting a thin-walled bulb in a beaker and placing a solution of sodium sulphate on the inside and outside. The amount of current passing through the glass is measured with a galvanometer when potential differences of from 10^5 to 10^8 volts are applied to the two sides through connecting tubes of electrolyte. From the observation that the solution on both sides of the glass remains neutral during electrolysis, the conductivity is found to be purely electrolytic and not electronic. The relation between specific resistance ρ and potential follows closely the Poole equation $\log \rho = A - BX$, where X is the potential in 10^6 volts/cm. and the constant B has, at 20° C., a value of approximately 1, but falls with increasing temperature. Similar measurements made with calcspar and quartz show that with these materials the current conducted decreases progressively with time. With quartz no stationary end-value is obtained. J. N. P.

2791. *The Theory of Electrolytic Reduction. Acetone.* **E. Müller.** (Zeits. Elektrochem, 33. pp. 253–259, June, 1927.)—Reducing acetone, which is not easily reduced, in 1911 [*ibid.*, 17. p. 972], Tafel obtained widely differing proportions of the products, propane and also isopropylalcohol and pinacone when using kathodes of cadmium, lead and mercury. The author and F. Schulze electrolyse an aqueous acetone sulphate solution in a diaphragm cell (porous pot); CO and CO_2 were not observed in the kathode gases. No reduction was observed with kathodes of platinum and copper; amalgamated zinc and cadmium gave the highest yields of propane, over 90 %; mercury, lead and silver came next in efficiency. There is no parallelity between potential and propane formation. The author suggests that the ion H· cannot exist as such, but can exist on the kathode from which it borrows an electron. The bondage H·|M would probably be more loose than that of H··H in H_2. Reduction of the acetone molecule would take place when the molecule hits the kathode with a C or an O atom. There is primary formation of alkylmetal which would explain the catalytic influence of the kathode material; it is not merely a question of supertension. The chemical reduction of acetone does not appear to yield propane. H. B.

2792. *Passivity of Metals from the Standpoint of the Activation Process.* **D. Reichinstein.** *Part I. The Activation Process and the Stationary Evolution of Gas at the Anode.* **W. v. Reyter.** (Zeits. Elektrochem. 33. pp. 237–244, June, 1927.)—Investigation of the stationary current density-e.m.f. curves for the anodic evolution of oxygen at platinum in 0·1 N — and 1·8 N — sulphuric acid solutions reveals a new effect, namely, that on passing from a higher to a lower current density, the polarisation potential falls lower by 17 to 30 millivolts than would correspond with the smaller current density in the stationary state. T. H. P.